THURSDAY, OCTOBER 9, 1884

## THE CHOLERA POISON

THE reporter of the French Commission appointed to investigate the mode of action of the cholera poison and its method of propagation, as judged of from the behaviour of the disease during the epidemic in the southern provinces of France, has made public the conclusions which have been arrived at. It will be remembered that the French Commission which studied the same subject in Egypt last summer differed from the German one in regarding the blood as containing the specific organism of the disease, a contention which found no support in this country when the medical societies had had an opportunity of examining microscopically the preparations which were supposed to afford proof of it. Dr. Koch, chief of the German Commission, on the contrary, declared that the French statement was due to an error of observation, and maintained that the comma bacillus which he had discovered in the coats and contents of the intestines formed the specific germ of the disease. The French Commission of 1884 now return to the subject by still maintaining that the blood contains the poison, and that the initial lesion of cholera takes place in the blood. In proof of this they describe the changes which the blood cells undergo during the process of cholera; they regard certain modifications, such as result from the entire loss of elasticity of the globules, as one of the most certain signs of the patient's impending death; they maintain that by the hourly examination of the blood of cholera patients the progress of the malady can be mathematically followed; they assert that cholera, as such, is transmissible to the rabbit as the result of the injection into its veins of the blood of a cholera patient at the algid period; and lastly, they maintain that the microbe specially described by Dr. Koch has no such specific properties as have been claimed for it.

So far the two sets of observations are diametrically opposed to each other, and neither of them finds much support from the investigations of Drs. Lewis and Cunningham in India. The French contention that cholera is transmissible to one of the lower animals is at variance with all previous trustworthy experiments, and until the details of the method of operating and of the symptoms induced are made public, it would be premature to accept the conclusion at which the Commission have arrived at as in any way proven. But, on the other hand, time is not lending support to the contention of the German Commission, and it is asserted that the early labours of Dr. Klein in Calcutta have confirmed the view which he has all along held, that the announcement of the discovery of a specific cholera organism in the comma microbe is, at least, premature. Fortunately, many observers are now at work in the field of cholera micro-pathology, and the opportunities which have been, and still are, afforded for such work both in Europe and in India are exceptionally favourable. The interests of science will be best observed by waiting for the results of the labours now in progress, and by the exercise of caution in accepting any views which are based on any isolated series of experiments. But whatever be the result, Dr. Koch and the German Commission must be regarded as having given fresh life to a scientific question the interest in which had for some time past been flagging, and to them must be given the credit of having secured in Dr. Klein's work at Calcutta the establishment of an English laboratory for the elucidation of a subject which this country should always regard as peculiarly its own, in view of the fact that among its possessions is the country which has always been regarded as the home of cholera.

## THE SANITARY INSTITUTE AT DUBLIN

THE Sanitary Institute of Great Britain succeeds, by its annual migrations from town to town, in securing a widely-diffused interest in matters relating to public health, and there are but few large towns in the United Kingdom that stand in greater need of some such stimulus than Dublin, where, under the presidency of the veteran sanitary engineer, Sir Robert Rawlinson, C.B., the Institute has met this autumn. Within the past twelve years we have made great strides in organising a sanitary administration in this country, every portion of which is subject to the control of a sanitary authority having at least two executive officers—the medical officer of health, who is intended to be a skilled adviser as to the principles which should be held in view in action taken for the promotion of health; and an inspector of nuisances, whose functions relate in the main to the periodic inspection of his district with a view of the removal of such conditions as are likely to cause injury to health, or nuisance. In Ireland a somewhat similar organisation has also been established, and, as in this country, the working of the system is subject to the control of a central body known as the Local Government Board. But to judge from a paper read before the Institute by Dr. Edgar Finn, there is a wide difference between the efficiency of the two systems, and it is certain that, whether judged by the progress that has actually been made or by the amount of money that has been raised by way of loan for the execution of sanitary works in England and in Ireland, the latter country must be regarded as comparing very unfavourably with the former.

According to Dr. Edgar Finn, this is partly due to the fact that the Irish Local Government Board is in itself unmindful of using the ordinary means at its disposal for enforcing the proper carrying out of the provisions of the Act under which it is constituted, partly to the circumstance that in the large mass of the sanitary districts the Boards of Guardians who have been constituted the sanitary authorities take but little interest in their sanitary duties, but mainly to the faults inherent to the system under which the medical officers of health are appointed in the rural districts. In Ireland the dispensary or poor-law medical officers are appointed to act as rural medical officers of health, and Dr. Finn points out that the miserable addition of from 10*l.* to 15*l.* to their other salaries does little more than suffice to induce them to hold their tongues, and to take no official notice of the conditions of dirt and unwholesomeness with which they come into contact. And not only so, but it is alleged that such officers cannot possibly be unfettered and independent in their action, for they are generally the medical attendants of the Guardians whom they serve, and who

are probably in most cases the owners of the properties needing sanitary amendment. In England, on the contrary, Dr. Finn points to the frequency with which rural sanitary authorities combine amongst themselves, and at times also with urban authorities, in the appointment of a single officer of health, to whom it is then possible to give such a salary as will command the entire services of a really competent and independent officer. The contention is true to a certain extent, but it must be remembered that the same system which Dr. Finn describes as faulty in Ireland is precisely the one which the poor-law inspectors, to whom the English Local Government Board originally looked for advice in this matter, secured throughout a very large portion of England when first the appointment of medical officers of health became compulsory in 1872, although it is true that the same Board has during the past five or six years been striving its utmost to undo the arrangement then carried into effect. It was originally felt that a local officer whose other duties necessitated his constant presence in every portion of his district would be the most competent of all to advise as to its sanitary circumstances, the more so as he, of all others, would have the earliest information as to the existence of preventable sickness and death. At first sight the idea seems a very plausible one, and if the principal duties of an officer of health were to be performed on the occurrence of disease, it might still find intelligent supporters. But it is essentially the prevention of the conditions leading to such diseases, and not their remedy after the disease has occurred, that should be looked for from the officer of health, and it is daily becoming more and more apparent that wider districts, supplying wider experience and commanding more skilled services, tend to this, rather than narrow areas which are only looked after during the performance of multitudinous duties of a more pressing character. It is not that the dispensary or poor-law medical officer is necessarily incompetent to perform the duties expected of an officer of health, for in England such officers at times hold both appointments with considerable advantage; but the great mistake which was originally made in England, and which has been repeated in Ireland, was to regard men as competent to perform the duties of one office merely because they held another office involving the performance of totally different duties.

The present is, however, a period of transition in this matter, and the public cannot expect to secure the highest procurable services until degrees and diplomas in sanitary science shall be so universally taken by those who seek public health appointments, that it shall always be possible to find candidates possessing the needful guarantee that they are competent to perform the duties of medical officer of health. The principle of combination by several authorities to secure the entire services of a single officer of health over a reasonably large area tends to efficiency, and most of such officers recently appointed have been able to prove their fitness for the post by the possession of some such diploma as we have referred to, and which can now be procured in each of the three divisions of the United Kingdom.

We have given this matter some prominence because of the importance which attaches to it wherever medical officers of health are appointed, but the Institute dealt at Dublin with many other subjects which are of equally pressing importance in Ireland. The need for improved dwellings for the poor, for adequate supplies of wholesome water, for efficient means of drainage, and for some proper methods for the disposal of refuse, are urgent requirements in many parts of Ireland. The lack of them causes needless mortality and sickness, and the methods by which they may best be supplied were fully indicated. As a test of the needs of the country in these respects, statistics as to deaths and sickness need to be intelligently examined, and amongst the contributions to the Congress few papers were of more value than that in which Dr. Grimshaw, Registrar-General for Ireland, dealt with the statistical measures of the health of communities, and so explained how a proper estimate of the health of a district may best be arrived at.

## *CONTRIBUTIONS TO PHENOLOGY*

*Beiträge zur Phänologie.* By Dr. Egon Ihne and Dr. Hoffmann. (Giessen: Published by the Authors, 1884.)

PHENOLOGY, the observation of the first flowering and fruiting of plants, the foliation and defoliation of trees, the arrival, nesting, and departure of birds, and such like, has attracted the attention of naturalists from time to time for nearly 150 years. Some have continued their observations for several years and have formed therefrom a "Calendar of Nature"; others have gone still further and have tried to deduce more general results. But the subject is beset with difficulties, especially when an observer endeavours to procure the aid of others, and this has proved so great at times that the work has not flourished as much as it deserved. The subject has been most carefully studied by M. Quetelet of Brussels, and his writings have served as the basis for most of the subsequent attempts which have been made at organising a System of observation. Dr. Egon Ihne of Giessen, in connection with Dr. Hoffmann, whilst endeavouring to form a series of Charts of plant-flowering for Europe generally, has consulted all accessible works likely to contain any information on the subject. This information is most generally scattered through the Transactions and Reports of Botanical and Local Societies, but still there is much to be obtained from other works, whose titles would not lead one at first to consult them for the purpose. The number and minuteness of the notices mentioned by these Professors, shows that they must have spent a long time in preparing this work, and very valuable service has been rendered to Phenology by publishing the list of sources from which information can be obtained. The total number of works noticed is 196, and naturally those published in Germany are most numerous. It will, however, surprise many to find that, whilst 102 German works are noticed, Great Britain with only 21 comes next, leaving 73 for the rest of Europe. It must be evident, therefore, that, notwithstanding the great care taken in compiling this list, there must be many works not noticed which contain phenological information, and the Authors would doubtless welcome notices of any works omitted from their list.

The main part of the book consists of a short account of the progress of Phenology in each of the countries of Europe, followed by a list of the works published in that country, with such short notes as may suffice to explain the nature of the information each contains. To this is

added a very complete index in two parts. The first part gives a list of the stations at which observations have been made, arranged alphabetically under the names of the countries of Europe in which they are situated; the total number of such stations is 1926. The second part consists of the names of these 1926 stations arranged alphabetically, with the years in which observations have been taken, and references to the works in which these observations are recorded. Some very curious facts may be obtained from this index. Whilst there are 315 stations in Great Britain, there are no less than 918 in Germany and Austria, and consequently 693 for the rest of Europe. But a more critical examination of the list reveals the fact that, of these 1926 stations, only 334 were taking observations in 1882, the date of the compilation of the work, and at only 97 of these 334 stations had observations been continued for ten years or more. Even this small number requires modification, for out of the 97 only 60 had observations for ten *consecutive* years, thus showing how spasmodically the subject had been treated till quite a recent date. Of the 1592 stations at which observations have ceased, there are only 210 with records of ten years and over. Considering the nature of the subject, ten years' work must be considered as the very least from which anything reliable may be deduced; whence, small as the number is compared with the large number of stations at which phenological work has been done, it is yet satisfactory to find that there is some good material to be obtained. Of late years the subject has been much more attended to, especially in England, since the Royal Meteorological Society took the matter in hand, and of the 334 stations at which observations are now taken, no less than 94 are in Great Britain and 112 in Germany.

Dr. Ihne regrets that the observations as taken for the Royal Meteorological Society refer to herbaceous rather than woody plants, and are exclusively confined to wild flowers and not to cultivated ones. His own list, which has been very generally distributed throughout Europe, has been drawn up on a different principle, and without entering into definite reasons, he condemns the Meteorological Society's list. Certainly in England, in the only case besides that of the Meteorological Society where a comparison of flowering throughout England has been tried, cultivated plants have been entirely excluded, being found by actual experience to yield no reliable results.

The second part of the work is taken up with an enumeration of the notices on the plants in the list issued by the Professors taken during the years 1879 to 1882. It would have been perhaps more convenient if they had been exhibited in a tabular form; at present it would be a work of some labour to extract the notices for the purposes of comparison.

## LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

### The Younger School of Botanists

A COMMUNICATION from the Rev. George Henslow to last week's NATURE (p. 537) concludes with the following passage:—

"There are not wanting signs elsewhere of the evil effects of the younger school of botanists not recognising the importance of first training students in a thorough course of practical and systematic botany before proceeding to laboratory work. In an examination lately held for a post at Kew, I am informed that two gentlemen who had been trained at Cambridge competed with a gardener for the post. The gardener secured it. *Verb. sap.*"

The last sentence is no doubt intended as a sort of *argumentum ad hominem*, which it may be admitted is not without a certain apparent force. Assuming for the moment the statement to be true, it must be pointed out that the only scientific posts at Kew which are open to public competition are those of assistants in the herbarium. These posts demand qualifications of a somewhat technical character, for which a general training in botany would by no means necessarily fit the candidates. I can imagine that a senior wrangler might fail in a competition for a post of computer in an observatory where arithmetical dexterity was the main thing required: a senior classic might cut an equally poor figure in seeking an appointment of library assistant if he were tested in the art of writing catalogue slips. I apprehend that in neither case would failure prove anything as regards either mathematical or classical education.

The examination to which Mr. Henslow alludes can only be one which was held by the Civil Service Commission during the past summer. There were, I believe, some dozen candidates; whether any Cambridge men were amongst them I am unable to say. But the successful candidate was not a gardener, but the laboratory assistant of the late Professor of Botany at Oxford—a gentlemen whose services the present Professor is in despair at losing.

On a former occasion it is true that one of our garden staff did obtain one of these appointments in an open competition. It is not very remarkable that it should be so. Men of ability on the spot have, of course, great facilities for seeing the nature of the duties required and for qualifying themselves accordingly; furthermore they have the advantage of the lectures of my colleague Mr. Baker, which are especially directed to the branch of botany which principally occupies us at Kew.

As to the larger question raised by Mr. Henslow, I am afraid I am not wholly free from some responsibility for the proceedings of "the younger school of botanists," the effects of which he regards as evil. In the face of the successful revival in this country of many branches of botanical study which the younger school has effected, I am emphatically of the opinion that these effects are the reverse of evil. I believe I was one of the first to organise a course of so-called laboratory work in botany on lines which it is only right to say were borrowed and extended from the teaching and example of Prof. Huxley. In what I attempted I had the generous aid of many now distinguished members of the younger school. I do not doubt that they have immensely improved on the beginning that was in the first instance somewhat tentatively made. But the principle, I believe, has always remained the same, namely, to give the students a thorough and practical insight into the organisation and structure of the leading types of the vegetable kingdom. When, therefore, Mr. Henslow, himself a teacher, asserts that such laboratory teaching as this should be preceded by a thorough course of practical and systematic botany, it appears to me that he is bound to explain what he precisely means by this very dark saying. For, if botanical laboratory work in this country is not thorough, is not practical, and, in dealing with types drawn from every important group, is not systematic, it is important to know in what respects it falls short of these requirements.

W. T. THISELTON DYER

Royal Gardens, Kew, October 4

### The Solar (Dust?) Halo

THE reddish halo to which Mr. Backhouse draws attention in his letter of September 20 in NATURE (p. 511) has of late been noticed by several observers, and this I think is because, while the sunrise and sunset glows have exhibited a marked decline in their duration and brilliancy since last winter, the halo has shown no similar diminution of intensity, and thus attracts more attention relatively than it did at first, when it remained for some time almost entirely unnoticed in this country. In reply to Mr. Backhouse's question as to whether this halo has been seen in England previous to last November, I have a very strong impression that it made its first appearance here coincidently with

the arrival of the unusual sunsets last year, and that it has never been seen here before, at any rate within the last twenty years. This impression is founded, first, on the fact that, like Mr. Backhouse, I have been in the habit of frequently looking at solar ha'os for years past. Secondly, I have been engaged since September 8 last year in a series of observations with anemometers attached to a kite-string (latterly wire), which has naturally necessitated my frequently looking up at the sky. I remember noticing the halo in November, and calling the attention of my assistant to the beautiful salmon colour it showed in the interstices of a mackerel sky, which shut off the direct glare of the sun.

On several occasions I measured its radius with a theodolite I was using, and in every case the value came out either $22\frac{1}{2}°$ or $23°$. It must therefore be due, like the ordinary ice-halo, to refraction through hexagonal prisms. I noticed it all the way going out to America in August last, and saw it beautifully when standing on the Terrapin Bridge over Niagara Falls on August 23. A large black cloud had shut off the sun's glare, and the red border happened just to coincide with the edge of the cloud. I called the attention of some American ladies to the spectacle, which they had of course never noticed before, and which they admired immensely. I regard the sunset glows as partly an intensification of the halo, produced by the greater thickness of the stratum through which the refraction takes place when the sun is below the horizon (the sunset, in fact, being formed of the upper half of the halo which lingers behind) plus reflection from the same stratum, which can of course only come into operation when the sun shines obliquely on it. The fact of the halo remaining constant while the sunset glows have become weaker may be readily explained on the hypothesis that the stratum has gradually sunk to a lower level than it had last winter, since the duration and even brilliancy of the glow must of course vary directly with its height, whereas the halo at midday need not be sensibly altered by a variation in its level.

Three weeks ago yesterday, I saw the sun rise from the summit of Mount Washington, 6293 feet above sea-level, and at ten minutes to five o'clock saw, in addition to the usual sunrise effects, a large circle of rosy purple haze situated about 15° above the horizon, and apparently having no connection with the yellow and red horizontal bands beneath it. The morning was exquisitely fine, the only clouds being a few light streaky cirro-strati, as shown in diagram, and the air was as clear as it only can be in America. I may add that the haze circle appeared almost suddenly after the first yellowish light had been visible for twenty minutes, and as soon as the sun rose above the horizon it seemed to vanish almost entirely. I have seen the sun rise from various altitudes up to 12,000 feet, but I never saw anything so curious as this sunrise before. In fact, I went up mainly to see it, and was not disappointed.

E. DOUGLAS ARCHIBALD

Tunbridge Wells, September 27

## Cole's Pits

YOUR note on the result of Gen. Pitt-Rivers' examination of the Pen Pits (Somerset) in this week's number of NATURE (p. 545) reminds me of a series of similar pits in this county of Berks, known as "Cole's Pits." They are situated near the branch of the Great Western Railway which runs from Uppington to Faringdon. I have visited them more than once when on visits to Wadley, the residence of my friend Mr. T. L. Goodlake, J.P. They correspond generally with the description given in NATURE of the Pen Pits, are probably of quite equal extent, are similarly situated on rising ground forming the cap of a ridge of hills, and are on the same Greensand formation. Many and various theories have been propounded from time to time by antiquarians, and of course the name by which these pits have been known for generations has been appealed to as connecting them with the "merry King Cole," and giving support to the views of those who regard them as traces of an "ancient British town." The utter absence of order in the arrangement of these shallow holes and rude mounds (for they are nothing more) excited my suspicion, nor could I see much in them to suggest occupation by any race which has inhabited these islands even so late as the time of the ancient Britons. On further investigation of them I came across a more modern sort of hut, consisting of a space rudely roofed over, the back of which was cut into the side of one of these grass-grown banks. The idea occurred to me that this would help to furnish evidence, since, if these hollows were dug in the strata of the hill to be roofed over for human habitation (the notion which, I am told, finds general favour) we ought to find some traces of *stratification* in a section thus presented to us. Not a trace of this was to be found; the section showed nothing but a chaotic mass of rubbly material with no more order in its arrangement than is to be found in the waste heaps of any old quarry or in a terminal moraine.

So far one's first impressions of the "pits" and mounds, as of an extensive series of old disused quarries, received confirmation. I cannot hazard a conjecture as to the extent to which quern-stones may have been obtained from the "Cole's Pits"; but it seemed to me extremely likely that the range of hills in question, here so many hills on sandy formations (our Bagshot Sands, for example) owed its existence, *quâ* hills, to the protection of the hard "paw" which is so frequently met with in such formations, which I have attempted to account for in the *Proceedings* of the Geological Association (vol. viii. No. 3), and which was certainly largely worked in places for rude building construction in very early times, large masses of it being seen still in the old Roman wall which to-day completely encircles the area occupied by the ancient town of Silchester. It is possible, too, that such ironstone may have been rich enough in the metal to serve as ore, when iron "forges" were common in past centuries in the forest districts of the south of England. Further support is given to the view which I venture here to put forward as to the origin of the Cole's Pits, by the fact that lower down the hill, and at a rather lower "horizon," there is a sand-pit open in the side of the hill, in which thin bands of ironstone occur, some of which, to judge from their specific gravity, might certainly have been available as ore, under conditions which obtained in the iron industries of the country a few centuries ago. A. IRVING

Wellington College, October 3

## The Flow of Streams

THE observations made by Mr. Maw on a stream flowing into the Lake of Thun are an extremely interesting example of well-known hydraulic laws. It would be well, however, if he would tell us what was the depth of the water; from the observed phenomena I presume it was small. Mr. Smith's very ingenious mode of practically showing the different strengths of a current from surface to bottom should also be supplemented by an account of the size of the stream operated upon. The situation of the point of greatest velocity varies considerably with the conditions of the river or stream, and is by no means fixed. The observations made on some large rivers, notably those by Mr. Revy on the large rivers of South America, seem to show that the greatest velocity is, in such cases, almost, if not quite, on the surface, and that from that point it diminishes uniformly downwards to the bottom. The ratio between the surface and bottom velocities is, however, a constantly changing one, and in large rivers varies with the depth of the water. Mr. Revy's observations seem to show that in large rivers, where the influence of the banks is practically inappreciable, the surface velocity varies directly as the depth, whilst the bottom velocity varies as the square of the depth; as the depth increases, the difference between the top and bottom currents diminishes, until at a depth of about 71 feet they are practically equal. These results are borne out by the observations of Messrs. Humphreys and Abbott on the Mississippi and Mr. Gordon on the Irrawaddy. All observations to be useful, therefore, should give the size of the river or stream operated on. If Mr. Smith has not seen the diagrams given by Mr. Revy in his "Hydraulics of Great Rivers," I think he would be interested in them. GEORGE HIGGIN

## Lepidoptera

I AM at present carrying on some researches here, for which a supply of living caterpillars of such large Lepidoptera as the Death's Head, Goat, or Hawk Moth is necessary. As I have had some difficulty in obtaining these, I should feel exceedingly obliged to any of your readers who may find or possess larvæ of the above or other large species, if they could furnish me with specimens. G. LOVELL GULLAND

Zoological Laboratory, University College,
Gower Street, London, October 4

### Animal Intelligence

MR. HARRISON, like most of those who deal with animal communications, assumes that sounds or words must form the basis. This rests upon the assumption that speech is a primary system of communication for mankind, instead of being secondary. Many babies will begin with sign communication, and show a preference for it after they are well able to articulate words. The dog will follow human gestures as well as sounds and words. It is indeed worthy of consideration how far signs play a part in communication between animals. Instead of supposing a complicated system of words, as Mr. Harrison does, it is easy to conceive that, with the apparatus he describes, many signs may be made. Expressions of alarm, joy, direction, can be as well made with antennæ as with hands.

32, St. George's Square, October 6 HYDE CLARKE

### Shifting of the Earth's Axis

PERMIT me to say that it was from the diagrams in the paper by Mr. Christie which he quotes (NATURE, October 2, p. 536) that I drew the conclusions of decrease of latitude. In the fuller statement to which I referred, I had expressly said that it was from the Polaris observations that a decrease of latitude might be deduced. The question turns on whether the truest result is obtained by trusting entirely to Polaris, or by including other stars which are at greater N.P.D. and have more variation in the refraction: as the former is less dependent on the most uncertain element of reduction—refraction—I inclined to rely on it entirely. It would be remarkable if the great oceanic circulation should have a mean axis of motion so nearly coincident with that of the earth as not to produce 1/100th of a second change in the Pole during half a century; the presumption would seem against such a fixity. W. M. FLINDERS PETRIE

Bromley, Kent

### To Find the Cube of any Number by Construction

CAPT. H. BROCARD (of Montpellier), writing to me on the subject of my note in last week's NATURE (p. 539), communicates the following two simple constructions:—

1. On two rectangular axes $Ox$, $Oy$, take $A$ on $Ox$ and $B$ on $Oy$, such that $\angle OAB = \alpha$, through $B$ draw $BC \perp^r$ to $AB$, meeting $OX$ in $C$, and draw $CD \perp^r BC$, meeting $OY$ in $D$: join $AD$. Then $\tan OAD = \tan^3 \alpha$.

2. Take $BOD = \alpha$, from $A$ on $OD$ erect $\perp^r$ to meet $OB$ in $B$: draw $BD \perp^r$ to $OB$, and let fall $AC \perp^r$ to $BD$. Then if we take $OA' =$ unity ($A'$ is the projection of $A$ on $OB$), $BC = \tan \alpha$, $A'B = \tan^2 \alpha$, $CD = \tan^3 \alpha$.

It may be of interest to note with reference to the figure indicated in my construction, that M. Brocard finds that if $FK \perp^r FD$ meets $CB$ in $K$, and $KL \perp^r FK$ meets $FO$ ($\perp^r BC$) in $L$, then $LD$ passes through $H$.

October 6 R. TUCKER

## *THE ASCENT OF WATER IN PLANTS*

THE fact that water is taken up by plants and passes off as vapour at the leaves is one of the best known data of vegetable physiology. The current of water passing up the stem of the transpiring plant is known, moreover, to be copious and rapid, and to pass through certain parts of the wood only. Apart from other questions, it has long been sought to explain by what forces this current can be maintained in the plant, and the difficulties which have arisen and been surmounted have been many; certain of these difficulties, however, are still outstanding.

It was an immense stride forwards when the fact was demonstrated that the water absorbed by the roots passes up the stem in the younger wood; and when it was recognised that in the Conifers this consists of definite elongated cells, not openly communicating, and is not complicated by the presence of vessels, &c., the problem promised to be much simpler.

As is now well known, the earlier hypotheses which were made to explain the ascent of water in transpiration have been long put aside, as new facts were observed which could not be satisfactorily explained by them: the old theory of capillarity succumbs evidently to the facts; and Quincke's hypothesis, though less easily despatched, must also be relegated to the list of past errors.

Two theories, or rather hypotheses, have attracted so much attention lately, that we may fairly regard them as the two rival views for the explanation of the ascent of the transpiration current. The one, especially advocated in its earlier shape by Boehm, seeks to explain the ascent as due essentially to the pressure of the atmosphere acting on a system of air-bubbles and water which can be shown to exist in the plant: this hypothesis, but shortly stated here, is obviously in contradiction to several important facts, *e.g.* the height of tall trees, and the difficulty of explaining how the atmospheric pressure could act on the closed system of the plant.

The second, and very different hypothesis, is the one recently proposed by Sachs. Assuming that the molecules of water imbibed by the wood cell-walls are held between the complex molecules of these walls in a peculiar condition—very much, in fact, as salt molecules are held between the molecules of water in the sea—then the difficulties in connection with tall trees disappear; for by the peculiar properties of the wood cell-walls it matters not whether a given molecule of water is a yard or a hundred yards high. This hypothesis undoubtedly explains numerous facts, and, if choice lay between it and the theory of atmospheric pressure only, no doubt could exist as to which we should accept; nevertheless, there are objections to it apart from the assumption of such very peculiar properties of lignified walls.

Before saying anything as to the possible modifications of the former theory, it will be well to see how it arose in the first instance.

Jamin, in the *Comptes Rendus* for 1860, published an investigation on some capillary phenomena, and particularly on the behaviour of capillary tubes containing air-bubbles in addition to water.

Suppose an open capillary tube of glass filled with alternating drops of water and bubbles of air. If pressure is exerted at the one open end of such a tube, of considerable length, it is observed that the pressure is not transmitted simply through the system, but that each successive one of the alternating columns of water causes a lessening of the effect. Of course each column of water, between two air-bubbles, has two concave ends, and the changes produced in these can be observed. Without here going into the explanation of this phenomenon of the apparent disappearance of the pressure, it suffices for our purpose that an open column consisting of air-bubbles alternating with drops of water may be placed upright and the water not flow out. Jamin showed that with long tubes, the water-columns of which were sufficiently broken by air-bubbles, even a pressure of three atmospheres applied to one end failed to move the lower parts of the column. Such a column of alternating drops of water and air bubbles is called a "*chapelet de Jamin.*"

It is known that porous bodies, such as gypsum, absorb water with great force: such bodies when saturated with water are very impervious to air, a fact which may be illustrated by means of the wet linen in any wash-tub. Jamin even proposed an explanation of the ascent of water in accordance with these facts, regarding the wood simply as a porous body.

It is not necessary to go into details as to the various modifications of the theories which in any way depended upon ordinary capillary phenomena; enough that the objection that, even if the plant had capillary tubes sufficiently fine to support the water columns required by a tall tree, the water could not flow through them so rapidly as the requirements of respiration demand seemed fatal to any of these theories, and made Sachs's assumption of the extraordinary properties of wood cell-walls appear the more necessary. Moreover, the Conifers have no such capillary tubes in the secondary wood.

It is impossible to put in a short space all the reasons which led Sachs to draw a sharp distinction between the behaviour of water entering into preformed capillary cavities or interstices, and water which is "imbibed," *i.e.* forces its way between the molecules or micellæ of an organised body. It may be remarked that cases may easily be supposed where it would be difficult to draw the line, and it is certainly not easy to see why "imbibed" water should be held less fast than water in capillary interspaces. It is just here, in fact, that the assumption of the extraordinary conductibility of wood comes in.

It is clear, then, that the great difficulty which is to be put aside by assuming, with Sachs, that the water of transpiration is held in a peculiar mobile condition in the substance of the cell-walls, is that of accounting for the great height of the water columns in tall trees. The old capillary theory will not explain this away, because, although the requisite columns of water could be *supported*, the water could not be *moved* as required.

Frederick Elfving brought forward an awkward objection to Sachs's theory a couple of years ago. By stopping up the lumina of the cells and vessels in such a manner that the edges of the cut elements could still be exposed, it was shown that no water could be pressed through a piece of wood. He showed, moreover, that coloured solutions passed into the cavities of the wood-cells through the thin membranes of the bordered pits, but—as must be concluded from his results—not through the thick substance of the walls. Objections have been raised to some details, but it seems difficult to avoid the conclusion that Elfving's results contradict every other view than that the water passes through the thin membranes of the bordered pits, and through the cavities of the elements, and not through the main substance of the walls of the lignified cells.

Elfving has recently published a paper on this subject ("*Acta Soc. Scient. Fen. nicæ,*" t. xiv. 1884) proposing an important modification of the views hitherto held. It is needless to go into the reasons why the theory of gaseous pressures generally must be abandoned, even in its later form, as was Boehm's air-pump theory before; though it is instructive to note that much insight into the physics of the plant may be obtained by a careful study of Boehm's, and especially Hartig's, views, and the various criticisms of them. We may, however, summarise Elfving's remarks, and the chief points for criticism in all the views, as follows.

In advocating the "imbibition theory," no proof is afforded that the lumina of the elements of the living wood are ever *entirely* devoid of water: some water is always present at least in the cells. This does not go against either theory; but the proof that the cells were at any time entirely devoid of water would decidedly support the "imbibition theory."

Enough has already been said as to why we may reject the theory of atmospheric pressure.

Confining our attention to the wood of Conifers, for obvious reasons, the chief facts are as follows. As the young wood-cells lose their protoplasm, water, containing air in solution, occupies the cavity, and bubbles of air are formed alternating with drops of water—in fact, a series of "*chapelets de Jamin*" are formed; only, instead of being simple and in one long tube, each one is complex, and the broken water-columns are confined in closed chambers permeable (to water, but not to air) at the bordered pits, and therefore communicating. One advantage of this is that the "*chapelets*" are less easily broken.

Elfving then passes on to show that, according to Jamin's researches, these columns of water may be of any height likely to come under our consideration: we have thus no more difficulty as to the *suspension* of the continuous columns of water—continuous, that is, in a serpentine course. The molecules of water can pass between the supporting bubbles of air as if they had no weight, since it is only the movement of the masses of water as a whole in the longitudinal direction which is prevented by the capillary forces in the "*chapelet de Jamin*"; the individual particles of water have perfect freedom of motion, and will of course travel towards the transpiration surfaces.

Elfving then goes on to show that many other facts are explained by his theory, and especially the loss of conductivity for water in branches cut off in the air. We must refer the reader to the original paper, however, for further details.

In conclusion, while there is no doubt that Sachs's ingenious "imbibition theory" of the ascent of the water in plants was startling, on account of the bold assumption of the peculiar condition of the water in the cell-walls, it must not be forgotten that it was suggested after a series of profound researches into the properties of wood, and by a master-mind which had tried all previous explanations and found them wanting; moreover, the strangeness of an hypothesis is in itself no argument, and so long as the "imbibition theory" explains more facts than any other it must be accepted on those terms.

If, however, the theory proposed by Elfving turns out to explain the same number of facts equally well, it will have to be allowed that it rests on a foundation of a very different nature, and which can be experimentally tested. It is not easy to suggest a distinctive name for the latter theory; perhaps it might be known as the "step" theory, since the intra-cellular movement of the water up to the leaves seems to be somewhat of the nature of a series of ascents by steps, or from side to side. We recommend the subject to the careful consideration of those physicists who have an adequate knowledge of the structure of plants.

## NATURAL SCIENCE IN TASMANIA

ALTHOUGH the scientific energy of Tasmania is not all that could be wished for, still the Royal Society of Tasmania is doing something to keep the flame alive. It is much to be wished that some of its hundred Fellows would devote themselves to an investigation of the flora and fauna of their districts, about which there is still much to be learnt. The *Proceedings* of the Royal Society for 1882 and 1883 have just reached us. The volume for 1882 contains over 180 pages, and is illustrated by four creditably executed lithographic plates. The details of the proceedings at the monthly meetings of the Society are first given, then follow the papers, the more important of which are as follows:—On the fishes of Tasmania, with a classified catalogue of the hitherto recorded species, by Robert M. Johnston. Incidentally he mentions that out of a population of 120,000 persons, it is estimated that about 1050 persons are directly dependent upon the capture and sale of fish. Hobart is the chief centre of the industry. Out of the 188 known species, about one-third are regarded as good edible fish, though only some 21 of these are sufficiently abundant to be ranked as of importance from a food point of view, and of these, some, like the sprat and anchovy, are quite neglected, from want of knowledge and want of energy. Among the so-called fresh-water fish, *Lates colonorum*, though a well-known fish in Australian waters, is confined, so far as is yet known, in Tasmania to one small river discharging into Anson's Lagoon, on the north-east of the island. Though not a sea-going fish, it is chiefly to be found at the mouth of small streams whose connection with the sea is frequently closed by shifting sand-bars; and possibly in this way it became originally acclimatised to fresh water. The fresh-water herring (*Prototroctes marœna*) is said to be the finest of the native fresh-water fishes; chiefly insect-feeders, they give the angler some sport. Some fourteen years ago they suddenly almost disappeared

from most of the rivers where formerly they had abounded, and thousands were seen floating dead down the stream, destroyed apparently by some species of Saprolegnia. It is satisfactory to note that of introduced fish the colonists have now a fine non-migratory trout (brown trout) and a splendid sea-going migratory salmon, the exact species of which is still involved in uncertainty. Among marine fishes special mention is made of the Barracouta (*Thyrsites atun*) and Kingfish (*Th. solandri*), which abound all the year round; but there would appear to be next to no attempt to cure the fish for the foreign market. Mr. R. Etheridge contributes a paper on Trilobites and other fossils from the Lower Silurian rocks of the Mersey River district, Tasmania. Several new species are described, and the species of Trilobites and Brachiopods are figured. Lieut. Beddome describes sixteen new species of Tasmanian shells, and Messrs. Higgins and Petterd some new species of Antechini and Muridæ.

The volume for 1883 contains 65 pages and but few memoirs. Messrs. Higgins and Petterd describe in it some new Tasmanian mice, and the same authors contribute an interesting account of a new cave-inhabiting spider. This species (*Theridion troglodytes*) was found in a recently-discovered cave in the Chudleigh district. The cave was found to consist of several chambers, in the innermost of which the spiders were found. The floor of the cave is about thirty feet below the level of the present entrance, and is only reached by two well-like descents of from fourteen to sixteen feet each, connected by low passages. There was also found a large deposit of mammalian remains, some in the crevices of the rocks, others embedded in the earthy and stalagmitic floor. These remains can be all referred to non-carnivorous marsupials and mice. It is strange that no insects were found, but the cave would seem to be worth a more detailed investigation, which the authors promise, adding that the stalactites surpassed in beauty those of the well-known Chudleigh Caves.

## *EXPLORATIONS IN ICELAND*

### The Lava Desert of Ódáðahraun

IN about the central region of Iceland, on the northern skirts of Vatnajökull, the largest glacier in Europe, is situated the most extensive occidental lava desert, the Ódáðahraun, covering a total area of about 16,000 square miles English. The whole of this wilderness is almost entirely one barren mass of lava, though here and there the traveller may observe patches filled with drifts of sand giving growth to some few stray tufts of upright lyme-grass (*Elymus arenarius*); but frequently a journey may be made through this region for days together without one single blade of grass being sighted. The total absence of vegetation and water in these tracts makes travelling here excessively arduous and risky, and these difficulties are still more aggravated by the elevation of the country above the level of the sea, in consequence of which it may frequently happen, even in the midst of summer, that the traveller is enveloped in blinding snow-storms, which preclude all attempts at further progress while they last. In such predicaments no reliance can be placed on the compass, because of iron entering so very largely into the composition of the lava-masses. Hence this desert has hitherto remained a *terra incognita*, and has never been surveyed; yet volcanoes of gigantic dimensions are found here, and many natural phenomena beside, which command great scientific interest. Not only to the world of science has Ódáðahraun been an unknown region, but even the inhabitants of the surrounding country-side have at all times entertained the most vague and ignorant ideas concerning it. For ages they pictured it to themselves as the home of trolls and mountain sprites. Even as late as the present century it was commonly believed that up among the volcanoes there were to be found verdant valleys containing a whole population of outlaws; a belief which took its rise and received its fortification from the fact that jets of steam issuing from the crevassed mountains were taken by distant beholders for smoke ascending from the chimneys of the abodes of outlaws. The outlaws themselves were pictured to the imagination as either human beings of a savage type, or as some preter-human race of gigantic strength. So firmly ingrained in the people was this belief, that even as late as 1830 an armed expedition was despatched from Mývatn for the purpose of exploring the haunts of these communities of outlaws, the result of which, I need not say, proved discouraging.

In ancient times one of the highways of the country ran across the northern portion of Ódáðahraun, which early records show the bishops of Skálholt to have been in the habit of taking on their visitation tours to the east country. This road was used for the last time in 1736, but has been lost since, and now no one is able to point out its locality and direction. Across the southern portion of the lava no attempt at forcing a passage had ever been made by man until a certain adventurer named Pjetur Brynjúlfsson, in 1794, succeeded in threading his way from the East Fjörds westward between the lava and the northern spurs of Vatnajökull, until he struck the road of Sprengisand, which traverses the country right across from the northland to the southland quarter. In 1838 Björn Gunnlaugsson, the famous constructor of the best map of Iceland, undertook a journey of exploration to Ódáðahraun, but fell in with such tempestuous weather that all his attempts at exploration were defeated, and he himself barely escaped with his life. Next year he repeated his journey, and, being favoured with better weather, he forced his way from the south up into the boundary line between the lava and the glacier, and pushed on some distance to the eastward. In this trip he attained some positive results. In 1840 a Danish naturalist, Schythe, intending to explore this region, took the same route, but was overtaken by such excessively stormy weather that, after having lost most of his horses, he just escaped with extreme difficulty into the country-side of Jökuldal in the east country. From this time no attempt at reconnoitring this wild country was hazarded until the stupendous explosion from Askja in 1875 gave such surprising evidence of the enormous activity of the volcanoes in these wildernesses. This year Mr. Watts made his way right across Vatnajökul, striking Askja in his descent over its northern spurs. Shortly afterwards Askja was visited by an Icelander, Jón Thorkelsson, who made his way up to it on foot in the midst of winter. In the summer of 1876 the Danish Government despatched Prof. Johnstrup with a party of scientific men to these volcanic wastes, who explored the region of Askja and constructed a map of the volcanoes. Prof. Johnstrup's is the only scientific exploration that ever yet was carried out in Ódáðahraun. At more recent dates Askja has been visited by several English tourists, such as Messrs. Lock, Coles, and Morgan. In 1880 several farmers from the districts of Mývatn and Barðardal made the complete circuit of Ódáðahraun. But, in spite of all such reconnoitring trips, the whole of Ódáðahraun is practically unknown yet, with the exception of the corner occupied by Askja.

Instructed by the Government, I have now for several years been engaged in surveying the upland tracts of Iceland, exploring the country geographically, and examining into its geological structure and character generally. This summer I resolved to attempt an exploration of Ódáðahraun with such means as I had at my command. With a view to more expeditiously effecting my purpose, I adopted the plan of selecting certain fixed stations on grassy spots here and there about the wildernesses which

surround the lava (the Ódáðahraun), and from each of these in turn, as my base of operations, to undertake trips into and about the lava to such a distance as circumstances in each particular case seemed to warrant. To attempt any comprehensive survey of the whole lava at once, the explorer must be supplied with a far larger stock of ponies than I, with my limited means, could muster, and unless such an expedition can carry sufficient fodder for the animals, any lengthened sojourn in one and the same spot is out of the question. But, by the method of exploration that circumstances forced me to adopt, the result must always come short of one's aspirations.

During the first part of July, which I spent in the country-side of Mývatn, I was engaged in examining the volcanoes of the neighbourhood, which for the most part as yet are quite unknown. I also investigated the geology of the country generally, made collections of insects and plants, and ascended the highest mountain peaks in order both to take the bearings of the mountains about Ódáðahraun, which are visible from Mývatn, and to connect my surveys with such points in the neighbourhood as Björn Gunnlaugsson had formerly fixed trigonometrically. Having finished my outfit and other preparations, I started on July 16, from the place where I am now writing, for the desert. The weather was cold and threatening, with snow-showers travelling along the higher mountain rises. Our first day's eastward march took us over the mountain called Námafjall into the large wilderness of Mývatnsöræfi, which is bounded on the east by Jökulsá í Axarfirði, the longest river in Iceland. Generally speaking this wilderness is covered with old lavas, which are connected with that of Ódáðahraun; but plains of drift-sand open here and there, which are studded with hillocks sustaining tufts of *Elymus arenarius*. In these wilds are found a great number of craters arranged in rows on defined lines from north to south, many crevasses, and rifts floored with earth at the bottom (jarðföll, *i.e.* earth-falls, sinks, or dips), which is but what might be expected, where so many lavas have welled forth from the disruptured bowels of the earth. In this locality there occurred a great eruption in 1875, and in shaping our course to the more southern localities, which were the object of my exploration, we passed close under the northern skirts of the new lava which that eruption created. As the day wore on, a gale of wind arose, and in such a case travelling over these parts ceases to be a pleasure. For some time we had the sand-storm at some distance to the northward before our eyes until it overtook us at last; columnal clouds of brown ashes are whirled into the air, and on joining together in ever increasing numbers the whole view soon becomes enveloped in such dusty darkness that eyesight becomes of little avail; eyes, nostrils, ears are filled with pulverised sand, which is of such a fineness as to penetrate without difficulty even the traveller's clothes; drifts of it find their way into the boxes, and gather together under the saddles and the packing gear on the horses: when in contact with the skin it causes great irritation and general discomfort to the body.

As we proceeded through this wilderness, we were struck by the frequent occurrence of horses' bones, in some cases singly, in others in masses, peeping through the sand between the hillocks. This day, by 11 o'clock at night, we halted in Fjallagjá, a long glen between two rifts, where we found *Elymus arenarius* growing in considerable quantity, but no water; it was a troublesome task to secure our tent in the loose drift-sand, but after repeated attempts we succeeded at last in fixing the pegs tolerably securely in the flanks of the hummocks among the interwoven tissues of the roots of the upright lyme-grass. In the evening the temperature fell to 30°·2 F., and during the night the earth was covered white with snow; our ponies spent the uncomfortable time in constant attempts at running away, which, however, were frustrated by our vigilance. The following morning the same weather continued, still alternating all through the day between sand-storms, snow-showers, hail and sleet squalls. With our view obscured so that we could not take any bearings of the mountains, we still pushed on all day long in a southerly direction, reaching our baiting-place to the south of Herðubreið late at night, in some grass plots along the River Lindaá, a tributary to the above-mentioned Jökulsá, which it joins close on the northern spurs of Herðubreið. The evening came on bitterly cold, and with such a thick fog that even the mountain of Herðubreið in our close neighbourhood was rendered invisible. From this spot, where I remained for a fortnight, I directed my excursions in various directions about the eastern portion of Ódáðahraun. Herðubreið is one of the highest mountains in Iceland (5290 feet), and of remarkably commanding aspect, terminating, towards the top, in a shoulder of precipitous rocks capped with a cone of perennial ice. This mountain, in spite of repeated attempts, has never yet been ascended. In a north-westerly direction from Herðubreið there arises a mountain-range of considerable length, on a line from south to north, which is called Herðubreiðarfjöll or Dyngjufjöll ytri (the outer, *i.e.* northern, Dyngjufjöll), and is utterly unknown. My first excursions I directed to the examination of these mountains. To the south of this range there rises a great volcano called Dyngja, built up of layers of lava with an inclination of 8° to 9° on all sides and rising shield-fashioned to an elevation of 3600 feet; it bears a close resemblance to the famous volcano Skjaldbreið in the south. On the 19th I set out to examine this volcano. Starting in the early morning from my tent on the banks of Lindaá, I had to traverse a lava plateau 1500 feet above the level of the sea, and such was the difficulty of travelling here, that frequently we were on the point of giving up all further attempts at pushing our ponies on, but by dint of perseverance we reached the volcano after a tortuous scramble of four hours and a half. The layers of lava forming the slopes of this volcano are excessively rough and of peculiar formation, all split up into fissures from north to south or hollowed out by caves and lava bubbles. Wherever the foot is planted the ground sounds hollow; in every direction there are innumerable hornitos, seemingly formed originally of a variety of strands of the fiery ooze twisted into all sorts of fantastic shapes, the outer surface suggestive of a tangle of intertwisted snakes of inordinate thickness. When we had made the ascent half way up the mountain, we were overtaken by fog and snowstorm, so that in a short time all objects were hidden out of view and the earth covered with snow. Still in the expectation of the fog clearing away, and the snowstorm blowing over, we went on, and after two hours' brisk walk reached the summit of the volcano. Here all was covered with ice and snow in a temperature of 28° F. Although the blinding snowstorm prevented anything being seen, I set my theodolite on the chance of the darkness clearing, and had to wait for an hour and a half shivering in the biting blast, when the weather so far cleared that I could take the bearings of several surrounding mountain peaks. This volcano has never been ascended by any man before me, nor would the fact have been passed over in silence, if such had been the case, for even in Iceland the activity of fire has hardly left any traces behind comparable to what is witnessed here. The original crater is 1500 to 1600 feet in diameter, and has, some time subsequent to its first formation, been filled with masses of lava, and now exhibits in the centre a large patch of lava round the circumference of which there stand twelve peak-formed lava columns. In the centre of this plain again there is an enormous crater 400 to 500 feet in diameter and 600 to 700 feet deep. It is hardly possible to picture to the imagination any sight more stupendous than that which

opens to view by looking over the verge of this crater down into the precipitous abyss. The crater, with its bottom covered with snow and the sides all whitened with a glacial crust, suggests to the beholder a gigantic cauldron hollowed out in marble. Enormous rocks, which have tumbled down from the brim of the crater, look like minute black specks against the whiteness of the bottom. The composition of the lava is practically entirely basaltic; but reddish rocks of trachyte are strewn about the circumference of the original crater, which shows that sometimes trachytic eruptions have taken place here, as in Askja in 1875. When the weather cleared, I had distinctly in view the greater part of Ódáðahraun as well as Dyngjufjöll proper, and all the lava currents which have taken their course from the latter complex of volcanoes. In a north-westerly direction from the above-described volcano is another, lower, but quite as wide in circumference, to which we gave the name of Kerlingar-Dyngja. Having surveyed Dyngja, we returned the same way we had come, and reached our tent at half-past two o'clock the next morning.

In a southerly direction from Herðubreið there extends a very considerable mountain range, 3400 feet high, which is called Tögl (Tails); it is separated from Herðubreið by a narrow gate through which, once upon a time, a lava current has found its way. Thus Herðubreið is surrounded by lava on all sides, though that mountain itself is no volcano, but a pile of coarse palagonite breccia interspersed with stray thin layers of basalt throughout its lower parts. One of my excursions I directed to the Tögl. From the tops of these mountains an extensive view opens southward over the sands along the course of Jökulsá and the northern region of Vatnajökull. The aspect of the country to the south of Herðubreið is truly forbidding, all covered with the yellow-gray scoriæ from the explosion of Askja in 1875, generally one to two feet in thickness, and no sign anywhere of vegetation. The whole southern horizon exhibits the vast expanse of the snow-white glacial bolsters of Vatnajökull, out of which, in a northerly direction, rises the enormous complex of volcanoes called Kverkfjöll. In some fiery convulsion this mass of mountains has split from end to end, and through the rent a glacier has found its way right down to the level land below. To the west of this rent I observed in the jökull a mass of craters, from one of which huge clouds of white steam ascended into the air. Nothing is known about the volcanic activity in this spot, no one having ever visited those parts of Vatnajökull. On the western side of Kverkfjöll the jökull is one flat ice plateau all the way down to Ódáðahraun, skirting into a number of moving glaciers terminating in sands and extensive moraines, from which flow innumerable affluents to Jökulsá in Axarfjörd. Towards the east, about the approaches to Sandfell, the next highest mountain in Iceland (5800 feet), the jökull exhibits sharp-cut black vertical walls, probably ledges of underlying basaltic belts; but further to the west the flatness of the jökull owes its formation to the substratum being made up of palagonite tufa, a softer and more easily ground material. Our western view was determined by a part of Ódáðahraun, southern Dyngjufjöll, Askja, and the southern parts of Herðubreiðarfjöll. At the southern termination of Dyngja there rises a very peculiarly formed tufa "fell," along the crest of which is to be observed a row of a number of vertical tufa peaks, each from one to two hundred feet high, so that the outline of the mountain gives the impression of a gigantic hedgehog.

Next day I set out on the examination of Herðubreiðarfjöll. Directing our course to the north-east, we ascended on our way a mountain by the banks of Jökulsá called Ferjufjall, near which, as the story goes, there was a ferry in those olden times, when the bishops were in the habit of taking that road over the northern skirts of Ódáðahraun, to which I have alluded already. In a north-westerly direction from this place excessively ancien lavas come to view, which are clearly older even than the Glacial period, exhibiting everywhere large and unmistakable signs of glacial abrasions. In this excursion we came upon a row of those beacons which by general custom in Iceland are erected to point out where roads run through wildernesses. Most of these beacons were but cumuli of stones; one, however, we found still standing, covered with moss and lichens. This we knew now must be the eastern end of the long-lost road, an assumption which subsequent discovery corroborated. As we approached nearer to Herðubreiðarfjöll we came upon a series of craters surrounded by a recent lava, and so rough that no horse might cross it, almost impassable even for a traveller on foot. Leaving our ponies behind, we made our way across this lava, however, as best we could, and reached the highest crest of the mountains shortly before sunset, and enjoyed from it an extensive view. All about these mountains, which are composed of palagonite breccia, there is a number of ridges observable, with small dales and narrow dips scooped out between them, all, however, totally barren of vegetation. About the central portion this range sinks down into low necks honeycombed with many large craters, from which floods of lava have spread over the surrounding country on both sides, east and west, covering an area of some tens of square miles. Having completed my survey of this region, we returned and joined our ponies shortly after midnight, all scratched and lacerated from the lava, with our shoes and stockings in shreds.

TH. THORODDSEN

Reykjahlíð, near Mývatn, August 4

*(To be continued.)*

## THE CONNECTION BETWEEN CHINESE MUSIC, WEIGHTS, AND MEASURES

CHINESE music can now be heard by all who desire to hear it at the Health Exhibition, and more may be learned on the subject from the pamphlet published by the Commissioners for the Chinese department. A curious account of the common origin of Chinese weights, measures, and musical notes is contained in a paper read some years ago before the German Asiatic Society of Japan by Dr. Wagener. The story is based on native legends, and is also to be found among the Jesuit "Mémoires concernant les Chinois." Dr. Wagener says there is not the slightest doubt that the Chinese system of weights and measures is more than 4600 years old; and it is a highly remarkable circumstance that, quite irrespective of the fact that it is more scientific and exact, it possesses all the advantages for which the French metrical system is so much praised. In the first place, it starts from a basis supplied by Nature; secondly, the decimal arrangement is almost consistently employed throughout; thirdly, linear and dry measure proceed directly from the same unit as the measure of weight; and lastly, what the metrical system does not do, it regulates in the simplest manner the relations of musical notes, which latter form the starting-point for the whole system of weights and measures. The following account of the origin of this system (says Dr. Wagener) contains fact and fancy mingled, but it is easy to distinguish between them. In the reign of the Emperor Hoang-ti, who ruled over China in the twenty-seventh century before Christ, the scholar Lyng-lun was commissioned to complete the musical system which had been discovered 250 years earlier, and particularly to lay down fixed rules for making musical instruments. Naturally he had to commence with the bamboo, which had already been long used to give the note for other instruments. He therefore betook himself to the province of Siyung in North-Western China, where, on the northern slope of a range of

high mountains, a species of bamboo grew, which, on account of its uniformity and its structure, being neither too hard nor too soft, was exceedingly suitable for a wind instrument. He cut one down and tried it. Tradition says that it gave the same note as his own voice when he was excited by no emotion; and the rippling of the sources of the great Hoang-ho, or Yellow River, which were in the vicinity, followed in the same tone. At the same time the fabulous bird Fung-Hiang, accompanied by his mate, flew to the place. Both perched themselves on a neighbouring branch, and commenced a song, in the course of which each of the birds gave six separate notes. These are the notes which are called the six male and six female tones in the scale discovered by Lyng-lun, and which correspond to the ancient doctrine of the male and female principles in Nature. As a matter of course, the deepest of the male notes was the one already discovered by the philosopher himself. He now endeavoured to reproduce the other notes with the help of bamboo pipes, and succeeded. His task was now to lay down fixed rules as to the length of the pipes, so that thenceforth they could be easily constructed everywhere. For this reason, and also because such a scale of notes depends upon slight differences of length, and there were scarcely at this time instruments to divide great lengths, he necessarily arrived at the notion of passing from the less to the greater, and of laying down an adequately small natural unit for his measurements. That could be nothing else but a grain of seed; and now the point was to get seeds of the greatest possible uniformity. He chose a sort of millet, the *Sorghum rubrum*, the seed of which is of a dark brown colour, and which is said to possess the advantages of greater hardness and uniformity than that of the gray and other kinds. The seed is pointed at the ends, and from one point to the other the length is somewhat greater than in the direction at right angles. Lyng-lun now fixed the length of the pipe, which gave the key-note at 81 grains of the seed placed lengthwise in a row. But when the grains were placed breadthwise it took 100 grains to give the same length. Thus the double division of $9 \times 9$ and $10 \times 10$ was naturally arrived at. According to the dimension in question, it was called a musical or an ordinary foot, the latter being introduced with the decimal subdivision as a measure of length. The breadth of a grain of seed was 1 *fen* (a line), 10 *fen* = 1 *tsun* (an inch), 10 *tsun* = 1 *che* (a foot), 10 *che* = 1 *chang*, 10 *chang* = 1 *ny*. In subsequent times the line was divided into tenths, hundredths, &c. Lyng-lun also laid down rules for the breadth as well as for the length of the pipe, because, although the note is essentially dependent on the length, it is nevertheless necessary for its purity that the pipe should be neither too broad nor too narrow. He therefore fixed the circumference on the inside at nine grains laid lengthwise. With these dimensions, namely, a length of eighty-one grains, and an internal circumference of nine, the pipe which gives the keynote contains just 1200 grains, and this volume accordingly was made the unit of dry measure, and was called a *yo*; 2 *yo* = 1 *ko*, 1 *ko* = 1 *cheng*, 10 *cheng* = 1 *ten*, 10 *ten* = 1 *hu*. So far we see how the units of length and dry measure were connected with the musical keynote. The twelve notes of the scale are all derived from the keynote, and are to a certain extent comprehended in it. Hence if the 1200 grains contained in the pipe are divided among the twelve notes it gives to each a hundred, and the weight of these hundred grains was made by Lyng-lun the unit of weight. This was divided and subdivided on the decimal system until a single grain became the lowest weight of all. At a later period even the coinage became connected with this system, for one of the weights, the *leang*, corresponding to our ounce, became the weight of metal put into a coin, so that the modern *tael*, in which mercantile quotations are found every day in the *Times*, is merely an ounce of silver, and is thus directly connected with the musical scale. Finally, says Dr. Wagener, it appears from this account that, in China, weights, measures, coinage, and the tuning of musical instruments have been derived quite consistently from a constant unit supplied by Nature herself, and that the essentials of this system are over 4600 years old.

## NOTES

THE Queen has been pleased, through His Grace the Duke of Richmond and Gordon, to intimate a subscription of 25*l*. to the Scottish Marine Station for Scientific Research, Granton, Edinburgh.

THE Washington International Prime Meridian Conference discussed at length on Monday a resolution for adopting the Greenwich meridian, which several American and British delegates advocated. M. Janssen, the French delegate, opposed the motion in a long address, arguing in favour of what he called a "neutral" meridian, and suggesting that the prime meridian should run, either through Behring Straits, or one of the Azores. After some further debate the Conference adjourned subject to the call of the chairman. No opposition to the election of Greenwich was shown excepting by France, but doubts are expressed as to whether the Conference will have any result.

ACCORDING to the *Standard's* Calcutta Correspondent, the Commission under the direction of Dr. Klein, appointed by the Indian Government to examine into the cholera question, is satisfied that Dr. Koch's microbe is not the cause of the disease. The Commission is still continuing its inquiries, but so confident is Dr. Klein on the microbe question that he swallowed a number of them without any evil results.

"THE Philadelphia meeting of the American Association," *Science* states, "is credited with being the most successful up to this time. The total attendance was 1249. Great Britain contributed 303; Pennsylvania, 246; New York, 161; Massachusetts, 87; District of Columbia, 84; New Jersey, 58; Ohio, 57; Connecticut, 32; and Virginia, 22. The membership was increased nearly 25 per cent., 515 new members being elected, the number of members up to this meeting being 2033. The number of papers read was larger than ever before, and it is to be hoped that the weeding-out of the trivial matters so often offered was carried to a greater extent than usual. There was a general feeling that there was too much going on. A large portion of the physicists were engaged as examiners at the Electrical Exhibition, and were, of course, interested in the meetings of the Electrical Conference. Somewhat less science, and somewhat more time to enjoy the junketing, would be more in accordance with the desires of many, if one may judge from the opinions expressed on the way home. A proposition to confine the reading of papers to the mornings would have met with many supporters."

IT would seem that the International Scientific Association, which it was proposed at Philadelphia to organise, has been really founded. *Science* informs us that it has now a more assured existence, thanks to the fund of twenty thousand dollars which will be established through the liberality of Mrs. Elizabeth Thompson. Of this fund five thousand dollars have already been paid to the Association, and five thousand more will be paid next year on condition of ten thousand being raised from other sources. The income from this fund is to be devoted to research. Not only did Mrs. Thompson give liberally to this new Society, but she also gave one thousand dollars to the American Association for the Advancement of Science, to be used in researches on light and heat. Mrs. Thompson takes great interest in the recent marvellous advances in the application of electricity, and felt a desire to contribute, as far as lay in

her power, to the advancement of our knowledge of the forces of Nature. Appreciating the unity of energy, whether displayed as heat or light or electricity, Mrs. Thompson gave the money for researches as to the nature and sources of light and heat, in the hope that more may be learned of the connection which may exist between heat and light and electricity.

PROF. COSSAR EWART has sailed for the United States on a semi-official mission connected with the Fishery Board. He is to make full inquiry into the fishery regulations of the United States, to examine the fish hatcheries there, and otherwise to gather all possible information on the subject upon which he was engaged at home during last winter and spring with so much energy and success.

THE death is announced of Dr. Leopold Fitzinger, formerly custodian of the Zoological Court Cabinet at Vienna.

THE latest news from the Lena Meteorological Station at Sagastyr appeared in the last issue of the St. Petersburg *Izvestia*, dated January 3 and February 14. The small-pox, brought last year from Yakutsk, has made great ravages among the already scarce population of the delta. Nearly all (seventy) Yakuts living at Bouloun have died from the epidemic; and in the three settlements at Cape Bykoff forty persons died from it; even at Kytakh, close to the Meteorological Station, a Yakut who had fled from small-pox died in December last. The staff of the Observatory were quite well in February, and, with their provisions of fresh meat, were not afraid of scurvy. The magnetic storms were not so strong nor so frequent as last winter. The greatest cold witnessed in December was $-48°$ C., and, on the whole, the winter was far milder than last year. Frosts below $-40°$ were rare, and temperatures as low as $-52°$ were not witnessed this winter. The average temperature of February was only $-33°$, instead of $-41°$, as it was in 1883. On the contrary, strong winds were more frequent than last year.

THE new astronomical Observatory in Hong Kong appears to be now in full working order under Dr. Doberck. We have received its usual monthly weather reports, containing copious observations on the barometric pressure, temperature, temperature of evaporation and radiation, relative humidity and tension of aqueous vapour, duration of sunshine, rainfall, duration and velocity of the wind, &c.,—in all, fifteen tables. The meteorological work, especially when taken in connection with that of the Observatories at Siccawei, Manilla, and Tokio, and the observations at the various Chinese Customs stations and lighthouses must be of great value. For the benefit of shipmasters the Astronomer publishes daily a *China Coast Meteorological Register*, giving a summary of the atmospheric circumstances along the coast of China.

AT the same time as the German Association the German Meteorological Society met at Magdeburg and held a public meeting on September 20. Prof. Neumayer spoke on the development of meteorology and its importance in the life of nations. The following gentlemen were elected honorary members of the Society:—Profs. Buys-Ballot (Utrecht), W. Farrel (Washington), J. Hann (Vienna), G. Mohn (Christiania), A. Mühry (Göttingen), and E. E. Schmid (Jena).

PHYLLOXERA has made its appearance in the Pomological Institute of Proskau (Silesia). It is hoped, however, that the spread of the disease may yet be prevented.

THE Russian University of Kief has elected Profs. Kolbe, Helmholtz, Kirchhoff, Pettenkofer, and Hoppe Seyler as honorary members.

A COMMITTEE has been formed at Lucerne with a view of erecting what is called a "universal column." It is to measure 300 feet in height, and is to contain in its interior relief portraits of all the celebrated men and women of the present era on bronze tablets. Another project of the Committee is the building of a "museum of the nineteenth century," to be dedicated to art, science, inventions, commerce, and industry, and to contain the busts and statues of all distinguished persons in these domains. The cost is estimated at seven to eight million francs (280,000*l.* to 320,000*l.*), and is to be met by subscription, lotteries, &c.

THE old lighthouse erected by Smeaton upon the Eddystone rocks 125 years ago, recently replaced by a new lighthouse, has been re-erected upon the Plymouth Hoe. It was opened on September 24 with appropriate ceremony.

PROFESSORS and teachers of mechanics and mechanical engineering have the greatest difficulty in getting suitable models to illustrate the different machines, and combinations of parts, under discussion in their classes; diagrams go a long way as a means of illustration, but appear sometimes very complicated, more especially when the paths of the moving parts are drawn. Take, for instance, the link motion of the locomotive,—the diagram of the motion showing the relative positions of the different parts, when one of the cranks is placed in eight different positions in its path, is very complicated; when a model is used all this vanishes, the action being very simple, and perfectly plain to the average student. Then again the various arrangements of spur-driving gear, nest-gearing, and similar appliances, are very soon understood when illustrated with a model; with a diagram, or drawn on a blackboard, they look complicated and confusing. Perhaps the best and simplest form of demonstrating mechanics is by means of scale models, saving the teacher many long descriptions, and giving the student at once the best possible opportunity of understanding the construction as well as the motion of the different parts. We have before us an Illustrated Catalogue of Apparatus for Technical Instruction, &c. (manufactured by James Rigg, engineer, Queen Victoria Street), issued to meet the demand for appliances required in the various branches of technical education. The grouping of the several subjects is similar to that adopted by the Science and Art Department, the corresponding number of the Government list of 1883 is given side by side with the catalogue number, and the selection of models is decidedly good. The index includes all the subjects generally taught in technical classes. The models are constructed to secure strength and durability, without unnecessary finish, thus placing before the public a valuable series of models for the advancement of technical education at a moderate cost.

THE Japanese Government nominated Mr. Kikuchi Dairoku to attend the Meridian Congress at Washington. This gentleman is a Cambridge Wrangler, and at present fills the Chair of Mathematics at the Tokio University. It says not a little for the scientific advance of the Japanese that they can find one of themselves qualified to represent them at such a scientific meeting as that now being held at Washington.

WE have received from the Commissioner for Japan to the Health Exhibition a catalogue, with explanatory notes, of the exhibits of the Japanese Education Department now at South Kensington. It is not, we believe, generally known that the Japanese section was intended to have been much larger, and the articles were actually shipped from Japan; but owing to a fire on board the steamer by which they were being conveyed, they were spoiled. The loss was chiefly among the appliances, designs, &c., relating to art education, silk-weaving and embroidery by girls at the industrial schools, and specimens of work in bronze by the deaf-and-dumb. The pamphlet before us is much more than a bare catalogue; it is much more a long series of notes on Japanese education and educational appliances past and present, those dealing with the past being by far the

more interesting. On p. 27 we notice a curious statement. No. 61 to No. 85, says the catalogue, are works published by the University of Tokio. "As English translations accompany many of them, the visitor will be able to gather at once what they treat of," in other words, it is implied that the works were originally written in Japanese, and were afterwards translated into English. This is wholly incorrect; the works which are spoken of as "translations" are the originals, and were written by European gentlemen (whose names, by the way, are suppressed) in the educational department of Japan. Most of them were noticed at the times of their appearance in our own columns. They are all works of high scientific value, and their publication reflects much credit on the University, but, if any remark were necessary at all, it should have been that the Japanese was the translation, and the English the original, and not as stated in the catalogue. Exhibits 86 to 103 are the theses of the students in chemistry presented on graduation, and here the writer's name is in every case given. These papers are no doubt creditable in their way; still they are only the ordinary work of good students, while the others approach in many cases to the dignity of considerable volumes, and represent much labour and knowledge. Yet here the authors' names are withheld, and they are actually spoken of as translations. The writers were men whose names will long be connected with Japanese educational advancement—Messrs. Morse, Knipping, Korschelt, Ewing, and others—and the Commissioner can hardly have been ashamed to have their names in his catalogue, for all who know anything of Japanese education know how much science in Japan is indebted to the labours of these and others like them. Probably quite unintentionally there is not only the *suppressio veri* but also the *suggestio falsi* in the catalogue under this head.

AT the Working Women's College the opening address for the year to students and friends will be delivered in the Maurice Hall of the College, 7, Fitzroy Street, W., to-morrow (Friday) night at 8 p.m., by Mr. George Macdonald. Those interested in the work of the College are invited to be present.

MESSRS. LONGMANS AND CO. announce the following publications as forthcoming:—"Louis Pasteur, his Life and Labours," by his Son-in-Law; translated from the French by Lady Claud Hamilton. "The Science of Agriculture," by F. J. Lloyd. "Custom and Myth; Studies of Early Usage and Belief," by Andrew Lang, M.A. "A Manual of Telegraphy," by William Williams, Permanent Assistant to the Director-General of Telegraphs in India. "Above the Snow Line: Mountaineering Sketches between 1870 and 1880," by Clinton Dent, Vice-President of the Alpine Club.

WE have to record the death of M. Bourdon, the inventor of the metallic barometer and manometer which are so largely used.

IN the report last week of the paper read by Prof. Ramsay and Mr. Sydney Young before the Chemical Section of the British Association, "On Evaporation and Dissociation" (p. 551), in the sentence "as the dissociation *increases* the curves approach, &c.," "increases" should be "decreases." In Mr. Nicols's letter on "Salmon-Breeding" (September 25, p. 513, col. 1, line 13 from top), *paris* should be *pairs*.

THE additions to the Zoological Society's Gardens during the past week include a Lesser White-nosed Monkey (*Cercopithecus petaurista* ♂) from West Africa, presented by Miss Ethel A. Hutton; a Bonnet Monkey (*Macacus sinicus* ♀) from India, presented by Mr. W. Phillips; two Great Bats (*Vespertilio noctula*), British, presented by Capt. W. St. George Ord; a Horned Lizard (*Phrynosoma cornutum*) from Texas, presented by Mrs. S. Russell; an Erxleben's Monkey (*Cercopithecus erxlebeni* ♀) from West Africa, a Common Marmoset (*Hapale jacchus*), a Black-eared Marmoset (*Hapale penicillata*) from South-East Brazil, a Pig-tailed Monkey (*Macacus nemestrinus* ♀) from Java, two Small Hill-Mynahs (*Gracula religiosa*) from Southern India, a Blue-bearded Jay (*Cyanocorax cyanopogon*) from Para, an Alligator (*Alligator mississippiensis*) from the Mississippi, deposited.

## *PHYSICAL NOTES*

M. GARBE has laid down the two following laws in connection with Lipmann's capillary electrometer:—(1) The capillarity constant of mercury is greatest when the electrical difference at the meniscus is *nil*, and, as a rule, its value is independent of the sign of this difference. (2) The electrical capacity at a constant surface of an electrode plunged in a liquid is purely a function of the electrical difference, independent of the sign of that difference, and is least when that difference is *nil*.

M. BEETZ has made a standard cell which is a modified form of Latimer Clark's mercurous sulphate cell. It consists of a tube in which a compressed cake of mercurous and zincic sulphates is placed; at one end of the cake the zinc pole is placed, and at the other end the mercury pole. On short-circuiting the following results were obtained:—

| | | | |
|---|---|---|---|
| 5 minutes ... | 1·440 volts | 6 hours ... | 1·437 volts |
| 1 hour ... ... | 1·439 ,, | 12 ,, ... | 1·434 ,, |
| 4 hours ... | 1·439 ,, | 48 ,, ... | 1·408 ,, |

The resistance was 15·700 ohms.

M. DECHARME has made some experiments comparing a drop of water falling on to a surface of glass, which he had covered with a thin layer of minium so as to preserve forms obtained, with a rifle bullet striking a target. He found a striking analogy in the results.

M. FOUSSEREAU has found the specific resistance of distilled water, in the same apparatus, to vary from 118,900 to 712,500 ohms, that is to say, in the ratio of 1 to 6. He accounts for this in three ways: (1) by the solution of the surface of the containing vessel; (2) by the solution of matter from the air; (3) to the effect of the dissolved matter during distillation. On the first point he found that at 15° C. after standing in a glass vessel for forty-eight hours the resistance fell 1/30. At 30° C. the change was more rapid, and at 75° C. the resistance varied, so that he was unable to make any measurements. The solution of gases from the air had only a small effect. On the third point great care was observed. Experiment proved that the addition of 1/1,000,000 of potassium chloride reduced the resistance 1/3; according to M. Bouty, hydrochloric acid is five or six times as powerful. In respect to ice, M. Foussereau found that at the moment of congelation the resistance increased nearly 15,000 times, and continued to increase as the temperature fell. Thus ice at −1° C. has a specific resistance of 4865 megohms, and at −17° C. 53,540 megohms. A sample of ordinary water gave 65 times the conducting power, whilst the ice from it was from 30 to 40 times as conducting.

HERR WARBURG has succeeded in electrolysing glass; the method that he adopted is as follows:—He heated a piece of soda lime glass to about 300° C.—at which temperature it is a conductor—and placed it between mercury electrodes. It was necessary to use from 15 to 30 Bunsen cells for a long period. He then found that at the anode side of the glass he had a layer of silicic acid; this layer very quickly reduces the strength of the current owing to its bad conductivity.

M. DUTER has made some very interesting experiments on magnetic shells. He finds that, if thin disks of steel be placed in the field of a powerful electro-magnet so as to magnetise them through from face to face, when they are removed from the field, they have almost entirely ceased to be magnets; but the faint trace left still showing that the disks were magnetised as shells. Again, M. Duter built up a series of steel disks, either separated by thin paper or cardboard, or placed directly together. This series was then magnetised with the disks in the same position as before: now on removing the whole from the field he found he had a permanent magnet, fairly powerful and regularly magnetised. His next step was to take the magnet to pieces by separating it disk from disk; each disk was then found to have almost ceased to be a magnet, but on placing them together again he found that he still had a permanent magnet, but weaker than before.

M. BOUQUET DE LA GRYE has invented a multiplying seismograph. The instrument has been fixed at Puèbla, and a series of observations made during November and December 1882 show twenty-two abnormal movements in one month, probably seismic, only one being felt at Puebla. The sun and moon have been proved to have a direct action on the pendulum, the sun repelling it and the moon attracting it.

M. A. RIGHI has published a paper in the *Journal de Physique* on "The Influence of Heat and Magnetism on the Electrical Resistance of Bismuth." He says that the resistance of bismuth increases between some temperatures and decreases between others. These variations can be drawn in a curve which shows a maximum at a low temperature, then a minimum, again another maximum just before fusing, and a second minimum whilst in a liquid state, this minimum being in value about one-half the foregoing maximum. The positions of these maxima and minima vary with the physical conditions of the bismuth; if the bismuth be cooled rapidly, the two maxima approach one another until they even merge together, and the curve becomes similar to a parabola. In the first case the two maxima occur at $-40°$ C. and 240° C., the intervening minimum being at 115° C. In the case of rapidly cooled bismuth the single maximum is at 50° C. These results only occur in commercial bismuth, and are more exaggerated as the bismuth is hardened in the preparation, wire showing them more than castings, and cold drawn wire more than hot. Pure bismuth behaves like an ordinary metal. The resistance of bismuth either pure or commercial is increased in the magnetic field; in some experiments the increase has been one-eighth of the original resistance. The increase in resistances is generally proportional to the magnetic force, and decreases with a rise in temperature.

IN a recent paper by M. Planté, he gives the result of some experiments made to arrive at the cause and explanation of ball lightning; he was led to these experiments by having one of his mica condensers destroyed by a similar phenomenon. He charged one of his condensers from his secondary battery of 800 pairs, when the condenser was pierced, and instead of a bright spark a small incandescent globule was formed, which moved slowly over the surface of the condenser, following the parts where the insulating layer had least resistance, and destroying the metal film; the path being most curious and erratic. This motion continued, and the globule lasted one or two minutes, until the batteries ran down. In the case of a condenser in which the insulating material was ebonite, a sound was emitted similar to a toothed wheel being rapidly rotated against a piece of cardboard or sheet metal; at the same time there was a strong smell similar to that produced when ebonite is burnt. M. Planté repeated this experiment with 1600 secondary cells, which gave an electromotive force of 46,000 volts, and obtained a similar but much more complicated result. The second experiment made was to make a condenser of two flat pads of filter paper moistened with distilled water and brought near together so as to f rm an air condenser; now on connecting this condenser with his battery he obtained an incandescent globule which moved about between the pads and passed from one to the other. In this case he noticed that if the pads became dry at any point the globule disappeared, but either appeared at some other point, or at the same point again, as soon as it again became damp. In this experiment he found that the globule lasted a much greater time than in the case of the mica condenser, which fact was owing to the greater resistance in the condenser plates which did not allow the battery to discharge so rapidly.

## GEOGRAPHICAL NOTES

To the *Bolletino* of the Italian Geographical Society for September Prof. Bellio contributes an account of a curious manuscript by the Sicilian missionary Fra Teramo Castelli (1597–1659), who spent the better part of his life in Trans-Caucasia. This altogether unique work comprises seven thick folio volumes, originally preserved in the Theatine Convent, Palermo, but, after the suppression of the religious orders, rescued from destruction and removed by P. di Marzo to the communal library of that city. Its peculiar character will be at once evident when it is stated that there is no written text, all the volumes containing nothing but pen-and-ink sketches and other illustrations, accompanied by brief legends or explanations mostly in Italian or indifferent Latin, but occasionally also in Greek and Georgian. This method was deliberately adopted by the author or artist to convey his impression of men and things, because, as he naïvely remarks, "we thus see at a glance the fact, which, if written out, would take up much time both of the writer and of the reader." Of the designs, of which there are altogether 1176, 347 are of little value, being occupied with mystic, devotional, or ascetic subjects. But all the rest are highly interesting, especially to students of geography and ethnography. The two regions chiefly illustrated are Mingrelia (basins of the Rion and Ingur) and Georgia proper (basin of the Kur), jointly stretching from the Euxine to the Caspian, and bounded on the south by Armenia, on the north by "the kingdom of Astacan," that is, the Tatar khanate of Astrakhan. Mingrelia is identified with the ancient Colchis, while Georgia, "quæ Gurgistan barbaris dicitur," is said to comprise not only Iberia, but also a part of Greater Armenia and a portion of Atropatia, or Atropatene. Frequent allusion is made to the great fertility, rank vegetation, and moist climate of the low-lying tracts, whence arise "dropsy, extremely dangerous tertian and quartan fevers, causing worms to abound in the stomach and flesh of the people, on which account they consume vast quantities of salt." They are otherwise describey as Christians of the Greek rite "with a little difference," very numerous and warlike, especially the highlanders, still sometimes wearing armour, and endowed with great physical beauty. There is a portrait of a certain Mamia "Gorielis Princeps Armatus," mounted on a charger, and dressed in a complete coat-of-mail, with high boots, helmet, plume, spear, and shield. It is curious that this practice of wearing armour still lingers among the Khevsur highlanders of the same region. A striking contrast to the Gorelian warrior is presented by the picture of Vominissa, a poetess wearing a simple robe, a double row of pearls round her neck, a head-dress also fringed with pearls, and a rich mantle lined with fur. She holds a quill in her right hand, a scroll of paper or parchment in her left, and round about are disposed an ink-bottle, more paper, a penknife, a pair of scissors, and a vase apparently containing perfumes. Another lady, the Princess Lipardiani, is provided with a fan somewhat in the shape of a violin, with a little square mirror let in at the narrow part, exactly of the same form as is still fashionable in the country. "According to the seasons they gather the harvests of barley, millet, grapes, and nuts," is a legend occurring under one of the numerous designs representing peasants reaping corn as high as a man and making sheaves such as are commonly seen in Italy. Elsewhere is figured a scene in a market town with the explanation: "Trade is carried on by barter; one hen for two pounds of salt, one sheep for two hens, one sword for two goats, one horse for three oxen," adding that all these values are determined by official tariffs. Amongst the sports is one called *trocus*, which from the accompanying description seems to be identical with the game of polo recently introduced into England from the East. "Four horsemen gallop about playing with a ball the size of an orange, which they endeavour to pick up from the ground, hurl into the air, and drive forward with a racket." Then it is added in Latin: "Equites ludentes hoc pacto ut aspicis rarissimi sciunt se ipsos gerere, requiritur agilitas quædam cum certo determinato impulsu ita ut si plus aut minores ponuntur spiritus non bene ludunt sæpeque quasi novi *fetotontes* cadunt in terra ab altis equis cursoribus." Under several characteristic portraits of natives occur Latin verses pointing out how the mental faculties and moral tendencies may be deduced from the form of the head and expression of the features, thus anticipating the doctrine of Lavater. Of forty-six designs figuring the Sultan and his Court, his army and chief subjects, several are of considerable ethnological interest, comprising portraits of Persians, Arabs, Tatars, Egyptians, Circassians, Indians, Chinese, Portuguese, and other nationalities. Appended to these figures is the, for the times, remarkably liberal sentiment that all nations have good and bad qualities irrespective of their religions, and that the Chinese have a good system of philosophy and theology, although different from that of Christian peoples. Prof. Bellio's paper is enriched with a large number of facsimiles conveying an excellent idea of these curious volumes.

THE two last numbers of the *Russische Revue* contain articles on the little-known peninsula of Kamchatka, its geography, natural resources, and the history of its conquest. The districts adjoining the sea are so mountainous as to be almost uninhabitable. There is, indeed, one magnificent harbour in Awachinska Bay, and on this stands Petropaulovski. A chain of volcanic

mountains, some of them reaching to a height of 5000 feet, runs down the centre of the peninsula, and through this the large navigable river Kamchatka makes its way to the Pacific Ocean. The valley of this river is the most cultivated portion of the district. The hills are covered with forests of fir, larch, cedar, birch, &c., and in these are found numerous wild animals, such as the fur sable, the otter, foxes of all colours, and the bear, which latter, on account of the great supply of food, attacks neither man nor the domestic animals. It is curious to note that the squirrel, which is universal in Siberia, is not found here at all. Swans, wild ducks, &c., are found in great quantities in the lakes and marshes in the interior, and their eggs, as well as the birds themselves, are taken in great numbers by the people. The fish which throng the rivers in enormous numbers in the summer form the principal food of the natives. For the most part they are salmon (*Salmo salar*), and are dried and stored up for the winter; but owing to the scarcity and dearness of salt the fish frequently become rotten, and the people suffer great privation. The rigour of winter is much softened by warm ocean currents, which create those thick continuous fogs that render the coast so dangerous to navigation. The total population of both sexes is put down at only 6500 souls, but owing to the total absence of agriculture, and to the primitive methods adopted for preserving food for the winter, these are frequently in a state of semi-starvation. For all except bare food they have to look abroad—clothes, utensils, tea, tobacco, &c., and all these they purchase by means of their fur sable, which is unequalled in any other part of the world. About 5000 of these skins are sold each year at 15 to 20 roubles each. At the beginning of the present century, cattle were introduced from Yakutsk, and, owing to the excellent grass and water, would have thriven well, but on account of the lack of industry or energy on the part of the natives, it was found impossible to lay in sufficient stores of fodder in winter. The question whether agriculture is possible in the peninsula has never yet been answered. Markets exist in the ports of Eastern Siberia, which are at present supplied with such articles as salt meat, butter, cloth, and hides from San Francisco. The main obstacle to agriculture is the excessively damp and constantly foggy climate. The sun seldom shines, and does not therefore give enough warmth for the growth of rye and wheat. The trade is almost wholly with California; and as there is little or no money there it is carried on by a system of exchange, the natives offering their sable skins in return for such goods as they require. The articles conclude with an historical sketch of the peninsula down to the annexation of the Amoor region to Russia in consequence of the treaty with China of 1860.

THE latest news from Col. Przevalsky communicated to the Russian Geographical Society is dated January 20 and March 22. In the first of his letters the Russian traveller writes from Dynyouan-in, where he was staying at the residence of the Prince of Alashan. After leaving Urga on November 20, he reached this small town in Alashan on January 15, after a journey of 740 miles across the desert of Gobi. The cold in the neighbourhood of Urga was very intense, and the mercury was sometimes frozen; in Alashan it was, on the contrary, quite warm when there was no wind. M. Przevalsky proposed to leave Dynyouan-in the next day, and *viâ* the Tchebsen temple reach Kuku-nor. He wrote his second letter from this place. He had crossed Southern Alashan and the Han-sou Mountains without difficulty. There he spent the month of February, principally in hunting and in zoological explorations, which yielded rich collections. On March 23 he was to leave Tchebsen for Kuku-nor. The Chinese authorities did not hinder his advance, but refused to give him a guide for the sources of the Yellow River (Hoang-ho); the indefatigable traveller did not, however, attach any importance to this refusal, being sure of finding the sources of the Hoang-ho himself. When the Tsaidam was reached, M. Przevalsky proposed to establish his first station there, and to continue his journey with a few men and provisions. His second station would be established at Ghast in Western Tsaidam. As to Thibet, he had decided to go to Lassa if the Thibetians did not oppose him. Otherwise he would explore only Northern Thibet as far as Lob-nor, endeavouring to penetrate as far south as possible.

ANOTHER traveller who has been sent out by the Russian Geographical Society, M. Potanin, wrote on April 17 from Tientsin. The expedition had reached Chefoo on April 13 on board the corvette *Skobeleff*, and continued the journey on board a Chinese merchant ship. They proposed soon to reach Pekin, and there to obtain authorisation for the journey to Ordos and Han-sou *viâ* Utay or Kuku-Koto.

IN a paper contributed to a recent issue of the *Revue de l'Histoire des Religions*, M. Léon de Rosny, the Japanese scholar, argues that one of the two chief chronological factors in the present Japanese race is the Aino. It has long been recognised that there was a certain intermingling of the original Japanese invaders with those whom they drove before them, and who now remain in parts of Yezo, the Kuriles, and Kamchatka; but M. de Rosny thinks that the Aino element is an exceedingly large one, and permeates the whole race. His arguments are based on an examination of the cosmogony described in the earliest works. He finds here two separate and distinctly marked mythologies, one of a transparently aboriginal character. The Japanese of to-day is, he believes, a mixture of the conquering yellow and the conquered white races.

THE Berlin Geographical Society heard a lecture on October 4 from Herr Robert Flegel, who has just returned from making an exploration in the region of the Niger, as agent of the German African Society. Herr Flegel's exploration has occupied the last two years, in the course of which he explored all Adamawa and discovered the sources of the Binuë; but his effort to travel from the Binuë to the Congo ended in failure, owing to the feuds and violence of the intervening tribes. Herr Flegel carried away with him the conviction that the Binuë is navigable for 1100 kilometres, and its chief affluents, as for instance the Taraba, for a distance of from fifty to sixty nautical miles during five or six months of the year. Herr Flegel is accompanied by two natives, who attended him on his travels, and who listened on bended knee and with crossed arms to the praise bestowed upon them by the President of the Geographical Society for their devotion to their master.

NEWS has been received from the leader of the German expedition in South America, Dr. von den Steinen. The expedition had arrived at Aldea dos Bacairis, on the Rio Paranatinga, the ultimate point from which regular communication with the civilised world is possible. Their journey had been considerably delayed by untoward circumstances and difficulties. They left Cuyaba on May 26, and reached Rosario on June 2. There they stayed a few days to purchase provisions. On June 14 they reached the first Aldeamento of the Bacairis on the Rio Novo, a tributary of the Arino. There they remained a week, making anthropological and linguistic investigations. They continued their march on June 21, and arrived at Aldea on the 28th. On July 5 they were to cross the Paranatinga.

A GEOGRAPHICAL SOCIETY is about to be founded in the Scottish capital; it is to be opened next month by Mr. H. M. Stanley.

## A GIGANTIC EARTHWORM

IT is well known that earthworms exist in many parts of the world of enormous size compared to those with which we are familiar in this country.

Dr. Templeton mentions (see *Proceedings* of the Zoological Society, 1844, p. 89) large worms which are abundant after heavy showers in many parts of the island; this species, named by him *Megascolex cœruleus*, is represented by a number of examples in the British Museum, some of which are certainly more than two feet long. In South America at least two distinct genera are to be found which attain to a very considerable size. Prof. Perrier, who is so well known as an authority upon the anatomy of the group, has given them the appropriate name of *Anteus* and *Titanus*. Dr. Horst of Leyden, also well known for his researches into the anatomy of earthworms, has published in the "Notes from the Leyden Museum" a description of two species belonging to another genus, *Acanthodrilus*, which measure three feet or so in length; they are natives of Western Africa. Australia and New Zealand are also inhabited by these gigantic creatures. Prof. Thomas, of Auckland, New Zealand, informs me that he has heard of a large earthworm two or three feet in length, which is to be found in the interior of the island, and one of similar size has lately been described from South Australia, by Prof. M'Coy, under the name of *Megascolides*. There is, however, a still larger species which inhabits South Africa. Forty years ago Rapp described

and figured an earthworm six feet two inches in length, which was obtained from the neighbourhood of Port Elizabeth, but since that time there does not appear to have been any further description of the animal. Being anxious to secure a specimen for dissection, I applied to the Rev. G. R. Fisk, who most kindly sent me a living one; it is the same species as that described by Rapp, but is not quite so large; it measured between four and five feet in length, and about half an inch in diameter; these measurements are, however, rather under than over-stated; it is not easy to get an exact idea of the length of the animal, since it expands and contracts within such very wide limits. The general appearance is much like that of the common British species, the bristles being disposed in four series of pairs to each segment; this outward resemblance is not borne out by the internal structure, which is very different from that of *Lumbricus* or any other genus.

These monstrous worms appear to be fairly abundant in the neighbourhood of Port Elizabeth and other parts of the Cape Colony (see the *Cape Times* for May 29, 1884), but are only rarely seen; they do not seem to move about at night like our British worms; only heavy and prolonged rains drive them to the surface from their underground burrows; on such occasions, as I am informed by a correspondent at Kleinpoort, which only take place a few times a year, the ground is often covered by hundreds of these creatures slowly crawling about in all directions; they must present a most remarkable sight; as a general rule they do not return into the earth after the rain has ceased, but remain above ground, and are shortly killed by the sun. The same gentleman states that the soil in which he has observed them is of a hard clayey nature, and retains a considerable amount of water, which is invariably brackish. This fact has some significance in connection with the geographical distribution of earthworms. It was formerly believed that earthworms and their eggs were killed by immersion in salt water, and consequently the presence of similar or closely-allied species in two regions now separated by the sea would be a strong indication of a previous land connection, setting aside, of course, those cases evidently due to man's interference (*i.e.* the importation of earthworms from tropical countries among the roots of plants). The fact that this earthworm from the Cape, and presumably its eggs, are unaffected by brackish water, and still more the occurrence of another genus, *Pontodrilus* (cf. Perrier, *Arch. de Zool. Exp.*, t. ix.), among decaying seaweed cast up by the sea, shows plainly that the greatest caution must be observed in drawing any such conclusions.

Zoological Gardens, N.W. F. E. BEDDARD

## THE ACTION OF AMMONIA UPON SOME LEPIDOPTEROUS PIGMENTS

TWO or three years back, some entomological friends induced me to kill all my insects with ammonia, instead of employing potassium cyanide, and I have never regretted the change I then made. Nearly the first species so treated was *Melanargia galathea*, and on opening the pill-boxes I was much surprised to find every one of them of a beautiful primrose-yellow colour. In a few moments the primrose-yellow had vanished and the insects were of their normal white again. Evidently this phenomenon was due to the volatile ammonia, so I held a specimen over the bottle, and instantly the primrose colour returned, only to disappear again with the departure of the pungent ammoniacal fumes. The reagent employed was a saturated aqueous solution of ammonia, and the black pigment of the wings remained unchanged throughout. Now here was something of great interest and well worth investigation, so I determined to follow it up, and since that time have never lost an opportunity for experiment or study. Many of my friends are now familiar with the results obtained, but as they appeared to be previously unknown to all those with whom I have communicated on the subject, I have thought it best to place them on record. They may be well known and authenticated, but to ascertain this a careful search through the vast mass of the chemical and microscopical literature both of this country and the Continent would be required, and for this my spare time is quite inadequate. I must therefore crave the indulgence of those who may be familiar with the facts herein recorded. Naturally, the first species selected for experiment was *Melanargia galathea*. As before, ammonia gave the primrose coloration. The next reagent employed was a solution of potassium hydrate, in which pieces of the wing were placed, and they immediately turned yellow. Other alkalis, such as solutions of sodium hydrate and barium hydrate, were tried, and gave similar results, the only difference being that with the fixed alkalis the primrose coloration was permanent, whereas with ammonia it was necessarily fleeting.

As alkali turned the pigment yellow, acids I thought might prevent this, or even produce another colour. Accordingly the wings were treated with a great many acids, the chief being sulphuric, nitric, sulphurous, hydrochloric, phosphoric, and acetic. With all these, when used in excess of the alkali, the pigment was restored to its natural white colour. I also found, that whenever the liquid employed was exactly neutral to both red and blue litmus, the pigment remained unchanged, whilst the slightest addition of alkali produced the primrose-yellow, and when acid predominated the normal colour prevailed. Thus, we see, this pigment is a good test for alkalinity.

To enumerate all the species experimented upon would occupy too much space, so I will only give the most important. As some Continental species are mentioned, I have followed Staudinger's arrangement. *Papilio machaon* and other Papilios were unchanged, and the same may be said of the genus *Thais*. *Parnassius apollo*, *P. delius*, and *P. mnemosyne* turned a pale yellow. With such semi-transparent species a deeper coloration could not be expected, from the small amount of pigment present.

None of the species of *Aporia*, *Pieris*, or *Anthocharis* showed any alteration with ammonia, but *Leucophasia sinapis* and its vars. *lathyri*, &c., exhibited a delicate primrose colour. Not a single species in *Colias*, *Rhodocera*, *Thecla*, or *Polyommatus* was changed; but the behaviour of the species of *Lycæna* was extremely curious and somewhat unexpected. *L. argiades*, *L. argiolus*, *minima* (= *alsus*), *semiargus* (= *acis*), *alcon*, *arion*, and *euphemus* remained unaltered. *L. bætica*, *argyrotoxus* (= *ægon*), *argus*, *opilete*, *orbitulus*, *eros*, *icarus* (= *alexis*), *eumedon*, *amanda*, *bellargus* (= *adonis*), *meleager*, *jolas*, and especially *astrarche* (= *agestis*), *corydon*, and *damon* were beautifully suffused with primrose on the under side and cilia, wherever the white pigment occurs. It is difficult to say why some of the species in this genus are unaffected, whilst others exhibit the most gorgeous colouring; but in the case of *L. argiolus*, at least, this may be accounted for. The pale bluish white of the under side is not the result of white pigment at all, but is due to reflected light from the almost pigmentless scales, in which a change could not be looked for. All the species which were examined in *Nemeobius*, *Charaxes*, *Apatura*, *Limenitis*, *Vanessa*, *Melitæa*, and *Argynnis* exhibited no change. In the Satyridæ, besides *Melanargia*, *Œnis ællo* is clearly suffused with primrose beneath. In *Satyrus*, *S. circe* and *S. briseis* have the white bands changed, but *S. alcyone* and *S. semele* are not affected. *Erebia* and *Pararge* are alike unchanged. *Cœnonympha hero*, *C. arcania* (and vars.), *C. pamphilus*, and *typhon* (= *davus*), have the cilia and under side deeply suffused with yellow. Of the Hesperidæ, *Spilothyrus alceæ*, *Syrichthus alveolus*, *S. serratulæ*, and *malvæ* (= *alveolus*), all have the whites changed to primrose, but *Nisoniades*, *Hesperia*, and *Carterocephalus* are not affected.

With the *Heterocera* I have obtained but negative results, although the number of species operated upon are to be counted by hundreds. It would be unsafe to generalise with such scanty data to go upon, but a few remarks may be ventured. The white pigmentary deposits of *Pieris* and *Melanargia*, although to the eye the same, must have a very different chemical constitution, and at one time I thought the negative ammonia results would be a good character of the Pieridæ, in contradistinction to *Melanargia*, &c.; but facts would not support this speculation, for *Leucophasia* proved refractory, and the Satyridæ gave results by no means uniform. Many more experiments must be performed. Nature must be thoughtfully questioned again and again before we can possess a firm basis for speculation.

Hitherto changes of colour only have been dealt with, and few reagents employed, but by recent experiments on the solubility of the various pigments in different media, most interesting facts have been brought to light, which in the future I hope to communicate. What a wonderful and lovely sight is the under side of *Vanessa atalanta*! It has at least a dozen shades of colour, most exquisitely mingled. Some day these colours will be analysed and their constitution made known. The results herein recorded may then be of service.

GEORGE COVERDALE

24, Fleming Road, Lorrimore Square, S.E., August 16

## SCOTTISH FISHERY RESEARCHES

APPENDIX F of the Report of the Scottish Fishery Board contains a series of valuable papers with accurate and well executed plates. Dr. Stirling gives a preliminary report on "The Chemistry and Histology of the Digestive Organs of Fishes." The first part gives the results of chemical investigations of the digestive processes in the herring, cod, haddock, and skate. The second part deals exclusively with the intestinal tract of the herring. The muscular coat of the œsophagus consists of striped muscular fibres arranged more or less regularly at the upper part, but disposed circularly in several layers at the lower. The mucous membrane of the œsophagus has longitudinal folds, and is lined with cylindrical epithelium interspersed with numerous goblet cells. The œsophageal glands are simple tubular glands, with, at first, a very short secreting portion. The glands in the "cardiac sac," or "crop," are, like those of the œsophagus, branched tubular glands lined in their upper part by tall columnar epithelium, and in their secretory parts by a single layer of cubical cells, like the "outer" cells of the fundus in mammals. The gland tubes become shorter towards the lower part of the cardiac sac, and they are absent in the pneumatic duct, which is lined by a single layer of columnar epithelium, and divided into two compartments by folds of the mucous membrane. Dr. Stirling has found that the organ which has been hitherto known as the "crop" in the herring, is something more than a mere receptacle, and corresponds in structure and function to the cardiac portion of the stomach of higher vertebrates. There is a striking resemblance between the cells lining the secretory portion of the gland tubes and the "outer cells" in the mammalian stomach, the point of difference being that the tubes are lined by a single continuous layer of these cells. There are apparently no internal layers of cells comparable to the inner cells of mammals, and, as might be perhaps expected, the glands are simpler than those of the mammals, and without that differentiation of tissue which is brought about by specialisation of function. One cell may subserve two functions, and, from an evolutionist's point of view, the secretion of an acid and the formation of a ferment have not as yet in the fishes been relegated to two distinct sets of cells. The pyloric sac or stomach is that short tubular organ with thick muscular walls, and resembling a gizzard, which opens out of the crop and is continued into the intestine. The surface of the mucous membrane consists of irregular depressions, which are deeper than those of the cardiac sac and may be regarded as crypts. The pyloric sac is always lined by a very thick coating of mucus, which not only lies on the surface, but dips down into the pyloric crypts. The surface of the pyloric sac and the glands or crypts are lined throughout with a single layer of tall, narrow, columnar epithelium, having the same character as that which lines the gland ducts and the surface of the cardiac sac. There is no muscularis mucosæ. The circular muscular coat is very thick, while the longitudinal is thin. Structurally the pyloric sac is comparable to the pyloric end of the mammalian stomach. Plates i. and ii. give series of figures illustrating various points in the anatomy of the intestinal part of the herring.

Prof. Macintosh gives a short note of preliminary observations made at the Marine Station, St. Andrew's, on the ova of various food fishes. Cod ova were specially examined, and experiments made as to their buoyancy and the effects of impure water, which proved very marked, and of changes of temperature. The small size of the yolk-sac, as well as the activity shown from the first by the newly-hatched fish show that they must soon take in nourishment from without. The ova of the common flounder were successfully hatched out. Other forms examined and experimented on were the long rough dab, turbot, *Cyclopterus lumpus*, herring, &c., and amongst invertebrates the ova of squids, *Natica*, whelk, nudibranchs, mussel, *Asterias rubens*, lobster, and shore-crab.

The vexed question as to whether the sprat is a separate species of the Clupeidæ or merely the young of the herring is satisfactorily settled in favour of the former opinion in the first part of the Report on the Sprat Fishing during the Winter of 1883-84, by J. Matthews Duncan, F.R.S.E., in which definitions of the differences in external and internal characters are distinctly proved. The sprat is more graceful in shape and slightly thicker in body than the young herring. The dorsal surface of the head is proportionally slightly longer in the herring, the operculum therefore extending further back. The suboperculum in the sprat is shorter and more triangular. The lower jaw is always longer and the diameter of the eye rather larger in the herring. In both sprat and herring the lower edge of the belly from the anal fin forwards is covered by a series of scales, having a central longitudinal "keel" and two lateral rays projecting forwards and upwards. These are more numerous but weaker in the herring than in the sprat, where the central keel is stronger and the termination forms a sharp point, so that the difference can easily be felt. In the sprat the pelvic fin is anterior to the first ray of the dorsal, whilst in the herring it is posterior to it. The pectoral fin is placed proportionately further back in the herring, and the centre of the dorsal slightly behind the centre of the body. The position of the dorsal fin varies more in the sprat, the position of the anal fin more in the herring. The number of rays in the pectoral, dorsal, and anal fins is not constant in either species, but appears invariable in the pelvic fin, that of the herring having two rays more. The arrangement of the teeth in both species is the same on the maxillæ, premaxillæ, and tongue, but those on the tongue are smaller in the sprat, and the vomerine teeth present in the herring are entirely wanting. The same superiority, as far as number is concerned, shown by the herring in the fin rays, scales, &c., is seen in comparison of other organs, the vertebræ, gill-rakers, and filaments, the branchial and pseudo-branchial filaments, and the branchiostegal rays, being all more numerous than in the sprat. The pyloric cæca are also more numerous. The slender duct by which the stomach (crop of Huxley, NATURE, vol. xxiii. p. 607) communicates posteriorly with the swim-bladder is slightly shorter and thicker in the sprat. In the herring the anterior end of the swim-bladder gives off two delicate branches, which run forward at first along each side of the parasphenoid, then diverge, and enter a small spindle-shaped capsule. From the anterior end of this capsule the duct passes out, and divides into two branches, one of which runs straight forward from the vesicle, whilst the other passes outwards at nearly a right angle. In the herring the ducts are very delicate tubes, measuring, in a herring 120 mm. long, 0·9 mm. in diameter, and are surrounded by a cartilaginous sheath, ·25 mm. in external diameter. The ducts meet posteriorly in the middle line, and open by a single aperture into the narrow anterior end of the swim-bladder. The spindle-shaped capsule is about 1 mm. long by ·6 mm. broad, and the spherical capsules are about 1·3 mm. in diameter, the anterior one slightly larger. The sprat, however, shows a remarkable departure from this arrangement. The ducts are about the same size as, and their form and direction are similar to, those in the young herring, though, at the point where they diverge from the parasphenoid (about 5 mm. from the swim-bladder) they lie higher, and are more difficult to follow. But the duct on each side ends in a *single* capsule only, exactly similar to that of the herring, and it neither forms a spindle-shaped dilatation, nor gives off a branch to a second vesicle. Thus, while in the herring there are three vesicles on each side of the head, all containing air, in the sprat there is only one. The foregoing differences are so numerous and so constant at all seasons that there can be no question as to the sprat being a distinct species from the herring, a further proof being that the former is found with developed milt and roe. Mr. Matthews shows in Plate iii. the difference between sprat and herring in the shape of the body and the keel scales, in the size of the ova, and in the formation of the air-vesicles of the ear.

In the valuable paper on the "Natural History of the Herring" Prof. Cossar Ewart, Convener of the Scientific Committee, treats of the varieties of the herring, the migration, the spawning-ground, the process of spawning, and the artificial fertilisation and hatching of ova. The varieties of the herring have long been discussed in all countries frequented by this fish, and differences believed to exist not only between herring of different countries, but of different districts and seasons. How far this may be true could not be determined even by careful examination and figuring of over 500 specimens, taken at different parts of the coast during winter and spring. Comparisons of outline show not so much that the herring of one district differ from those of another, but that there is a remarkable variation amongst herring caught at the same time. Heincke ("Varietäten d. Herings. Jahrb. d. Comm. in Keil, 1876-78") considers the position of the dorsal and pelvic fins of great importance, but, as specimens examined of the same length, caught at the same place, and as nearly as possible at the same stage of maturity, showed more difference than Heincke finds in his autumn and spring herring, some better character must be

considered requisite. It seems unlikely that the same herring spawn twice a year, but that the fish which spawn in the spring and autumn of one year do not spawn again respectively till the spring and autumn of the next year, in which case it is difficult to account for two distinct races of herring. It may be supposed that at first all herring were in the habit of spawning about the same period, but as time went on they were found spawning during every month of the year. Specimens of ova, for example, have been sent nearly every week from the Aberdeenshire coast, showing that herring have been spawning uninterruptedly in one district for at least ten months, from August 1883 to June 1884. The explanation of why at the present day there are two great spawning periods is not that spring and autumn are the two best periods for the depositing and hatching of the eggs, but that these are the two most favourable periods for the appearance of the fry, as then the surface-forms on which they feed are more abundant, as examination of the Ballantrae Bank showed. In the case of the herring the number of individuals does not depend so much on the number of eggs hatched as on the number of fry that survive. These when hatched are at first protected by their minute size and great transparency, and, given sufficient food, are likely to pass safely through the larval stage. If the larval food were more abundant in autumn and in spring, more fry would naturally survive at these periods, and this would ultimately result in the formation of great shoals of autumn and spring herrings. All that has been written on the migration of the herring leaves us still very much in the dark as to either the extent or the causes of it. Meantime, we may suppose that the movements of the herring are regulated during a greater part of the year by the supply of food, which naturally renders their movements very inconstant, and during the rest of the year by what may be termed their spawning instinct. This seems to imply several things, but it specially leads the herring to select ground suitable for the deposit of eggs, waters having a suitable depth, and water which will provide abundant food for the young fry. It has been long known, and was placed beyond doubt by the Fishery Board investigations of 1862-63, that herring were wont to spawn on hard ground. A very complete survey of the Ballantrae not only corroborated this fact, but showed that the herring even preferred to deposit their ova in the basin-shaped gravel-coated areas, where presumably the water is stiller than over the stone-covered ridges, and where it covered many square yards with a layer nearly half an inch in thickness. Eggs were also often found arranged in low masses over the surface of the long stems of laminaria. In several instances the dredge had apparently come upon part of the bank where the eggs lay "to a very great depth," but on examination it was found that the spawn, instead of forming thick masses, was arranged in irregular heaps ranging from a quarter to half an inch in thickness, and varying in size from scarcely an inch to nearly six inches square. By laying the portions side by side in a tank it was possible to obtain a very accurate notion of the arrangement of the undisturbed ova, which certainly often form a regular layer covering several yards of the bottom. On the east coast, judging from the specimens brought up by the long-line fishermen, the herring seem to select hard ground plentifully covered with sea firs, especially *Hydrallmannia* and *Antennularia*. Fishermen and others believe that there is some relation between the herring deserting any given spawning-ground—such as the once much-frequented bank off Dunbar and the equally famous Guillam Bank in the Moray Firth—and the loss of herring-nets during storms, or when over-fished. The reason is that nets loaded with putrefying fish, when left on the ground, cause the herring to seek more agreeable banks elsewhere. This pollution would be continued and extended by portions of the net continuing to fish during the whole season, so that not only might the eggs first deposited be destroyed, but fish which might have spawned on other portions of the bank be taken, and their eggs, though shed, rendered useless. In this way not only the greater part of a shoal, but, what is of even greater importance, nearly all the eggs deposited during the spawning period might be destroyed, and the survivors of the comparatively small brood hatched desert their birthplace as spawning-ground and cast in their lot gregariously with the first large shoal they met with. In the artificial fertilisation and hatching of herring ova the natural process of spawning was followed as far as possible, and many thousands of eggs treated in this way on March 8 hatched out on March 28, 29, and 30, the temperature varying from 41° to 44° F. When the eggs had been plentifully supplied with pure water, the extremely active embryos kept revolving or wriggling inside the capsule, till this ruptured and allowed the larval herring to escape head-foremost. But if the supply of pure water had been limited, the capsule gave way prematurely, the long, slender body escaped, but the head remained within, and the embryo usually perished in spite of all efforts to escape. The hatching was greatly expedited by the temperature of the water being slightly raised. As soon as the fry escape, they begin to try and ascend towards the surface, which they generally succeed in reaching on the fourth day, when they are found swimming freely about. This instinctive desire to rise to the surface as soon as they escape from the egg-capsule is evidently intended to bring them to the vicinity of the food, on which, after the fourth or fifth day, they depend for nourishment. Sketches are given (Plates iv. v.) of herring, illustrating the different positions of the fins. A map of the Ballantrae spawning-bank (Plate vi.), and drawings of a colony of *Hydrallmannia falcata* (Plate vii.) and *Antennularia antennina* (Plate viii.), with cluster of eggs attached A series of figures (Plate ix.) show the eggs deposited artificially on glass and naturally on stones, gravel, and on a lost net dredged at Ballantrae.

A number of interesting specimens received by the Board are likewise described and figured:—(1) A new Blenny (*Lumpenus lampretæformis*, Plate x.), believed to be the first specimen recorded from the shores of the British Isles; it measured 10·7 inches in length, and was taken in forty fathoms of water, fifteen miles off St. Abb's Head. (2) A fine *Torpedo nobiliana* (Plate xi.) taken off Lybster in forty fathoms of water. (3) A Comber (*Serannus cabrilla*, Plate xii.) taken off Shetland, the first recorded in the North Seas. (4) A Turbot (*Rhombus maximus*, Plate xiii.), dark on both sides, with an eye on each side of the head and rounded frontal process, taken off Anstruther. (5) A splendid Opah (*Lampris luna*), four feet in length, taken in seventy-five fathoms of water off Fluga, Shetland, and now being examined by Prof. Turner, F.R.S. Another item is a list compiled by Miss Maclagan of edible British fishes and mollusks, with their Latin, French, Italian, and German synonyms.

## THE BRITISH ASSOCIATION

### SECTION D—BIOLOGY

*Department of Zoology and Botany*

*Remarks on the Characteristic Features of North American Vegetation*, by Prof. Asa Gray.—The first impression produced on a visitor from Europe to the Atlantic coast would be the similarity of the flora to that of England, many of the plants being almost or quite the same. The larger number of these are obviously introduced. The mullein, the toad-flax, the ribworts, the milfoil, the clovers, thrive by every roadside as in England, and perhaps with even greater luxuriance, the competition being less. This strongly suggests the idea that the distribution of plants is not always due so much to adaptation as to opportunity. As one proceeds westward and southward, the difference becomes more marked, the European type gradually disappearing. But as European settlements extend, the settlers carry their plants with them, and the plants are well up to the time, and travel by rail. On the other hand, some plants, but a much smaller number, are carried from America to Europe, and naturalised there. Such are *Impatiens fulva* and *Erigeron canadensis*. Turning from similarities to differences, one of the first points that strikes a European visitor is the great wealth of trees and shrubs. This Prof. Gray illustrated by giving the number of European and North American species in the most important arborescent orders. The reason of this is probably to be found in the different conditions of the two continents during the period of glaciation. The flora of Europe is exceptionally poor in trees, and, on the return of a warmer climate, the return northwards of those that survived in the south was barred by the Mediterranean. The fossil remains of trees belonging to many tropical orders are found in our Miocene and Pliocene strata. In America, on the contrary, there was nothing to prevent their gradual return from the south, and accordingly we find solitary examples, or in some cases a larger number of representatives, of many tropical orders among the trees of the Northern States. Such are *Menispermum* (Menispermaceæ), *Liriodendron* (Magnoliaceæ), *Diospyros* (Ebenaceæ), *Tecoma* (Bignoniaceæ), and many others. This difference is also promoted by the greater heat of the American summer as compared with that of Europe. On the high lands of North America are also many Arctic plants, which

remained after the Glacial period had passed away; but this flora is insignificant compared with that of Europe. A few species are found on the cool shores of Lake Superior, the shores of Labrador, and certain summits of the Appalachian Mountains. One of the most interesting features of North American botany is an outlying region of a true tropical flora which extends northwards up the Atlantic coast as far as the "pine-barrens" of New Jersey. Proceeding westwards, whether in the States or in Canada, a gradual striking change is observed: not only do the European importations disappear, but European genera give place to those specially characteristic of the western continent. Here above all is to be observed the extraordinary wealth of Compositæ, which make up about one-eighth of the total phanerogamous flora of North America; great numbers of species of *Aster*, *Solidago*, *Eupatorium*, *Silphium*, and other genera. Between the wooded region of the Atlantic and the wooded region of the Pacific coast, there is an immense tract of woodless prairie land, the home of the "buffalo" and of many grasses; and in the spring the number of bright coloured herbaceous plants is also very large. These plains are destitute of water, and probably never grew trees, and are capable of growing nothing but herbaceous plants, which completely disappear in the hot dry summer. Then comes the great chain of the Rocky Mountains, which are well wooded on their sides, and have on their summits a flora of about 200 Arctic species. When the traveller reaches the Sierra Nevada, he enters perhaps the noblest coniferous forest in the world. But while the Pacific coast is extraordinarily rich in Coniferæ, it has a smaller number of trees belonging to other orders than the Atlantic coast; the entire absence of oaks, ashes, and maples, is especially remarkable.

*Observations on the Trapping of Young Fish by "Utricularia vulgaris,"* by Prof. Moseley.—Small perch just out of the ovum were found in the bladders of *Utricularia vulgaris*, some of them caught by the head, some by the tail; but very close observation failed to detect the actual act of capture. No process of digestion has been discovered, and the object of the capture requires further investigation.

*On the Jessop Collection, to Illustrate the Forestry of the United States in the New York Natural History Museum*, by Albert S. Bickmore.—The great importance of the forest industries and lumber trade of the United States led Gen. Walker, the Superintendent of the Tenth Census, to provide for a corps of competent experts, under the direction of Prof. Charles S. Sargent, who have made new explorations of our forest lands, and gathered original data regarding their present extent. The results of these elaborate researches have been partially published from time to time in the form of bulletins, and the completed work will soon appear in two large quarto volumes of the census series. To place this great fund of valuable information before the artisan and labouring classes in an accessible form, a great collection of our forestry and its products was needed, and this Mr. Morris K. Jessop offered to provide at his own expense. After the field work planned by the census had been finished, Prof. Sargent directed his assistants to return to the forests, and to carefully select the individually largest and soundest tree of each species. Prof. Sargent is preparing a manual which will be a guide to the collection, and which contains all the most important information in the large census volume that will be useful to the visitors and to the artisan classes. The museum is most fortunate in its location in Central Park, where more native and domesticated species are flourishing than can be seen together at any other place on the continent. This is the first effort yet made in this country to gather the native woods together into one collection on a scale commensurate with the extent of the new continent and the importance of its forests.

*On the Origin of Fresh-water Faunas*, by W. J. Sollas.—The author commented on the lack of interest which had been previously taken in the subject, and then referred to the experiments made by Bourdon in changing salt water into fresh. The old idea that salt water had been the mother of life was now generally acknowledged. In the River Jumna, one thousand miles from its mouth, were found marine forms of mollusks. We had to look further than change of temperature and the composition of the water for the manner in which marine specimens obtained their distribution. The currents of rivers always flowed seaward, and if free-swimming larvæ got a short distance up a river they were certain to be washed down again. The case was different with swift-swimming fish, the Salmonidæ, for instance, which were able to swim up stream and lay their eggs in lagoons. According to a table which he had prepared, nearly all the groups of fishes were both fresh-water and marine. He referred to the evidence afforded by geology to show that fresh-water forms were but modifications of those found in salt water. He believed the sea-water fauna had become fresh-water fauna in the times when tracts of salt water had become fresh-water lakes. He dwelt on the subject of secluded development, and concluded that the higher the organism the less possible was it to diverge from the parent stem. The tree of life at the present time rather put out new leaves than fresh branches.

Prof. Murat of Harvard briefly criticised the paper. The subject was one, he said, rather for suggestion than dogma.

*On the Concordance of the Mollusca inhabiting both sides of the North Atlantic*, by Dr. Gwyn Jeffreys.—It was recommended that this paper should be printed entire in the *Proceedings*.

*On the Identification of Animals and Plants of India which are mentioned by early Greek Authors*, by Prof. Valentine Ball, F.R.S.—He said that upon examination it had been found that many of the animals mentioned by Herodotus, Strabo, and other Greek historians, which had usually been regarded as myths by commentators, were easily identified as animals which were found to-day in the forests of India. For instance, the marticora mentioned by old classical writers, and usually regarded as a combination of tiger and scorpion, was really a tiger. It was said by the Greek writers that the marticora had poisonous whiskers and a sting at the end of the tail. In India to-day the inhabitants still regarded the whiskers of the tiger as poisonous, and when one was killed they always took care to burn the whiskers. With regard to plants, Herodotus mentioned the "Indian reed" or *Calamus indicus*, which was generally regarded by scholars as the bamboo. This was, however, impossible, as the bamboo did not grow large enough to furnish material for canoes, as Herodotus expressly stated that the *Calamus indicus* did. The speaker thought it was the Palmyra palm which grew in the valley of the Indus, and which was known in the Sanskrit language as the "Father of Reeds." There were many others of these animals and plants which could be identified, and when the writer's investigations were published he hoped it would be found that he had exonerated the old travellers from the imputations which had been cast on their veracity.

*On the Rudimentary Hind Limb of the Humpbacked Whale, Megaptera longimana*, by Prof. J. Struthers.—He said the humpbacked whale was extremely rare on the British coast. One had been seen often spouting for some weeks in December in the Firth of Tay; it was mortally wounded, and finally towed ashore dead near Aberdeen. It was a male, forty feet in length. After it had been exhibited for a couple of weeks at Dundee he had partially dissected it. Having been preserved, it was further exhibited, and he had only completed his dissection immediately previous to coming out. The presence of a rudimentary thigh-bone had been discovered in this species many years ago by the late Prof. Reinhardt of Copenhagen. The thigh-bone was composed entirely of a cartilage of conical shape, in length five and a half inches on the right side, four inches on the left; it was incased in fibrous tissue, and rested loosely on the pelvic bone without articular surface. Looking at the anatomical facts and comparing them with those of the other species he had referred to, the conclusion which must be arrived at was that the thigh-bone in the humpbacked whale was a rudimentary structure, a vestige of a more complete limb possessed by ancestors, from which it was descended. The skeleton of this whale would be placed in the Dundee Museum, he hoped, before the Association met in Aberdeen next year.

*On the Value of Nerve-supply in the Determination of Muscular Anomalies*, by Prof. D. J. Cunningham.—He spoke of the muscula sternalis as a new muscle in man, which had no counterpart among animals. It was, according to his experience, found more frequently among females than males, while Prof. Sheppard, of McGill College, had, he learned, had three cases, all among males.

Prof. Moseley said that this subject of the anomalies of the muscles had a very important bearing in solving many of the riddles of the evolutionary theory.

Prof. Struthers said that while it was not at all impossible that new muscles were starting up within us, it was also possible that the muscles might have existed before, and not been discovered, as our predecessors did not examine things as closely as did the modern investigators in muscular anomalies.

Dr. G. E. Dobson regarded this muscle as a rudimentary vestige of a muscle found in all the lower animals, by the use of which they are enabled to draw in their head and forelegs when they erect their spine.

*On the Mutual Relation of the Recent Groups of Echinoderms*, by Prof. A. M. Marshall.—Of these there were four groups, the common starfish, brittle starfish, sea-urchins, and holothurians. He said the nerve-system was originally derived from the skin. In some animals the nerve-system sank below, in others it remained near the skin, these latter being in a more primitive condition than those in which the nerve-system had sunk down.

Prof. Moseley characterised the paper as very valuable, having fully borne out all the discoveries of Prof. Carpenter, whose advancing age had prevented his being present.

A paper *On the Fœtal Membranes of the Marsupials*, by Mr. A. H. Caldwell, who was sent to Australia by the British Association to investigate certain interesting biological questions, was read, in his absence, by Mr. Sedgwick. It gave an account of the development of the marsupial embryo, which has been hitherto a riddle in biology. A letter from Mr. Caldwell as to the progress of his investigations in Australia was also read.

*On Some Peculiarities in the Geographical Distribution and Habits of Certain Mammals Inhabiting Continental and Oceanic Islands*, by G. E. Dobson, M.A., F.R.S.—The geographical distribution of mammals inhabiting continental and oceanic islands has been lately so ably treated of by Mr. Wallace, in his work "Island Life," that I do not purpose entering upon the subject from a general point of view, but will limit my remarks to some peculiarities of distribution which have attracted my attention while engaged in the special study of certain mammalian orders: I refer particularly to the Chiroptera and Insectivora. It is an interesting fact, not hitherto noticed, that many of the most characteristic species of the Chiropterous fauna of Australia have their nearest allies, not in the Oriental, but in the Ethiopian Region, thus contrasting remarkably with the avifauna. The remarkable genus *Chalinolobus* is represented only in Africa south of the equator and in Australia, a single species extending into New Zealand. Again, the species of the sub-genus *Mormopterus*, which belongs to a genus (*Nyctinomus*) of world-wide distribution, is limited to the same zoological regions, being found only in Africa south of the equator, Madagascar, the Mascarene Islands, Australia, and Norfolk Island. The presence of a species of this genus in Norfolk Island and its absence from New Zealand is very remarkable, for, as I pointed out for the first time about ten years ago, one of the two New Zealand bats known, namely *Chalinolobus tuberculatus*, is also common in Australia. The species of the extraordinarily specialised genus *Megaderma* have their headquarters in the Oriental and Ethiopian Regions; yet the largest species not only of the genus, but also of all known insectivorous bats, namely *M. gigas*, lately described by the writer from Central Queensland, has its nearest ally, not in any of the Oriental species, but in *M. cor* from Eastern Africa. Another very remarkable leaf-nosed bat, the type of my genus *Triænops*, found in Madagascar, Eastern Africa, and Persia, but unknown in the well-searched Oriental Region, has its nearest and only ally in *Rhinonycteris aurantia* of Australia, the type of another very peculiar genus. Finally, Australia agrees much more closely with Madagascar and the Mascarene Islands than with the Oriental Region in the species of the large genus *Pteropus*, for, while species of the section of which *Pt. vulgaris* of Madagascar is characteristic are well represented in the former regions, they are absent from the latter. Furthermore it is noticeable that, while 80 per cent. of the species of the genus inhabit the Australian Region and Madagascar with its islands, a single species only has found its way to the great continent of Hindostan and to Ceylon.

*On the Geographical Distribution of the Laridæ (Gulls and Terns) with Special Reference to Canadian Species*, by Howard Saunders.

*Result of the Investigations of Insular Floras*, by W. B. Hemsley.

*Some Observations on the Direct Descendants of Bos primigenius in Great Britain*, by G. P. Hughes.

*On Natural Co-ordination as Evinced in Organic Evolution*, by Dr. W. Fraser.

## *Department of Anatomy and Physiology*

*On the Presence of Eyes and Other Sense-Organs in the Shells of Chitonidæ*, by H. N. Moseley, M.A., F.R.S., Linacre Professor of Human and Comparative Anatomy in the University of Oxford.—The Chitonidæ have hitherto been regarded as characterised by an entire absence of organs of vision, the presence of eyes in the shells of numerous genera having been entirely overlooked by naturalists. The author first discovered eyes in a specimen of *Schizochiton incisus*, dredged by Capt. Chimmo, R.N., in the Sulu Sea, in which species they are larger and more conspicuous than elsewhere, and on examining carefully the shells of certain other forms, found eyes present there also. The eyes are entirely confined to the shells, and to the exposed parts of these, the "tegmenta" not occurring at all on the "articulamenta." They never occur on the girdle or zone, or any other part of the mantle. They appear as bright, highly-refracting, convex beads on the shell-surfaces, encircled by zones of dark pigment formed by the choroid layers. The eyes are usually circular in outline, and very minute, measuring in *Schizochiton incisus* about 1/175th of an inch in diameter, in *Acanthopleura spiniger* 1/350th of an inch, and in *Corephicum aculeatum*, in which they are oval in outline, 1/600th of an inch by about 1/400th. In the case of all the intermediate shells the eyes are confined to the areæ laterales, or to the lines of demarcation between the areæ laterales and the area centralis, which latter is usually entirely devoid of them. In some genera of Chitonidæ, such as Acanthopleura and Corephicum, the eyes appear to be often destroyed and obliterated in the older regions of the shells by decay and delamination of the tegmental surface, or its destruction by boring Algæ or animals. They are, however, constantly re-formed by the mantle in the process of growth of the shell at the growing margin of the tegmentum, and may be observed in this situation in all stages of construction. In other genera, such as Tonicia, the eyes lie in shallow pits of the shell-surfaces, and thus escape destruction by wear, nearly the entire number which have been formed being thus found present in fully-grown shells. The tubercles and prominences by which the tegments are covered in some forms serve, perhaps, as protections to the eyes from attrition. The entire substance of the tegmentum in the Chitonidæ is traversed by a series of branching canals, which are occupied in the living animal by corresponding ramifications of soft tissue and nerves. The strands of soft tissue are continuous with the tissues of the mantle along the line of junction of the margin of the tegmentum with the upper surface of the articulamentum by means of a series of tubular perforations in the shell-substance. Further, in the intermediate shells of most genera there are a pair of lateral slits (incisuræ laterales), one on either side in each shell in the lateral laminæ of insertion; these slits lead each to a narrow tract in the deep substance of the shell, which follows the line of separation between the area centralis and area lateralis. This tract is permeated by longitudinal canals, into which open a series of five apertures on the under surface of the shell. By these apertures numerous nerves enter the tract from the bed of the shell, and, traversing the longitudinal canals, give off a series of lateral branches on either side from it to the network within the tegmentum. In the cases of the anterior and posterior shells, there are usually a considerable number of slits present in the laminæ of insertion, each connected with a similar nerve-supply to the tegmentum. The network terminates at the surface of the tegmentum all over in a series of elongate cylindrical organs of touch, the plug-like ends of which are somewhat dice-box shaped, and can be protruded beyond the level of the tegmental surface from a series of pores, "macropores," by which this surface is covered. These larger organs of touch give off from their sides five branches of soft tissue, which pass vertically to the surface of the tegmentum, and terminate there in minute plug-like organs like the larger ones, but much smaller, and which are protrusible from a series of smaller pores (micropores) in the shell-substance. These smaller and larger touch-organs, and their corresponding pores, are disposed on the surface of the tegmentum with more or less exact regularity in different genera of Chitonidæ; in many cases in very definite lines and patterns. The eyes are connected with the same network of soft tissue as the touch-organs, and are apparently to be regarded as having arisen in development as special modifications of them. The soft structures of each eye lie in a more or less pear-shaped chamber excavated in the substance of the tegmentum. The stalk of the pear, which forms the canal for the passage of the optic nerve, is directed always towards the free margin of the tegmentum, and here its wall is pierced by a circular aperture, which is covered by the cornea. The cornea is calcareous, resisting the action of strong boiling caustic alkalis, but collapsing at once when treated with acid.

In section it is seen to be composed of a series of concentric lamellæ. Its substance is continuous with the general calcareous substance of the tegmentum at its margins. The pear-shaped cavity of the eye, formed by the shell-substance, is lined by a dark brown pigmented choroid membrane of a stiff and apparently somewhat chitinous texture. This membrane exactly follows the shape of the cavity, but, by projecting inwards beyond the margin of the cornea all round, forms an iris of a less diameter than the latter. A perfectly hyaline, strongly bi-convex lens is placed behind the iris aperture. It is composed of soft tissue, and dissolves in strong acetic acid. The optic nerve at some distance from the retina is a compact strand, but before reaching the latter has its numerous fine fibres separated and loose. The retina is composed of a single layer of rather short but extremely distinct nucleated rods of roughly hexagonal section, with their free ends presented to the light. Immediately behind them is a dense mass of nerve-fibres with numerous nuclei and nerve-cells interspersed. The retina is on the type of that of Helix, and not, as might have been supposed, on that of the dorsal eyes of Oncidium. A large part of the peripheral fibres of the optic nerve do not pass to the retina, but pass outside the eye-chamber by a series of apertures in the choroid round the iris margin, and end at the shell-surface in a zone of touch-organs encircling the eye. The touch-organs are identical in structure with the smaller touch-organs already described as appended to offsets of the larger touch-organs all over the shell. In giving off nerves to a series of such small organs, the eye thus corresponds exactly in structure to these larger touch-organs, and its homogeny with them is thereby clearly indicated. The arrangement of the eyes varies much in the different genera. In *Schizochiton incisus* the eyes are restricted to single rows traversing the lines separating the lateral area from the area centralis, and corresponding in portions with the incisuræ laterales and courses of the principal nerves. There are six rows of eyes, with six marginal slits on the anterior shell, and six on the posterior, and a single pair on each of the intermediate shells, twenty-four rows in all, with an average of about fifteen eyes in each, or, in all, 360 eyes. In *Acanthopleura spiniger* the eyes are irregularly scattered around the bases of the tubercles with which the surface of the tegmentum is covered, and are confined in the specimens examined to the region of the margins of the shells adjoining the mantle. The surface of the older regions of the tegmentum seems in this species especially liable to flake off, carrying the eyes with it, and it will probably be found, when series of examples of various ages are examined, that the eyes are originally more widely extended over the shell surfaces. In *Corephicum aculeatum* the eyes are very small, with corneas oval in outline, the long axis of the oval being directed vertically to the shell margin. They are never placed on the tubercles with rows of which the shell-surface is covered, but between the bases of these. The two kinds of pores lodging the organs of touch are arranged in vertical parallel lines with great regularity, the large pores occurring at intervals in the lines of smaller pores. The eyes are present in enormous numbers, the anterior shell alone bearing more than 3000, and the entire eight shells more than 11,500. In *Tonicia marmorata* the eyes are arranged in single straight radiating rows on the anterior and posterior shells. On each lateral area of the intermediate shells there are from two to four similar rows of eyes. In Ornithochiton the eyes are disposed somewhat similarly. In the genus Chiton, eyes appear to be entirely absent, though the touch-organs of two sizes and corresponding pores are present. In Molpalia, Mangina, Lorica, and Ischnochiton, I have as yet detected no eyes. In Chitonellus there are no eyes, and the supply of touch-organs is scanty and confined to the margins of the tegmenta. The arrangement and structure of the eyes and organs of touch will probably be of great value in the classification of the Chitonidæ, which has hitherto proved so difficult a problem. No traces of any structures resembling the eyes and touch-organs of the Chitonidæ can be detected in the shells of Patella or allied genera. The tegmentary part of the shells of this group appears to be something *sui generis*, entirely unrepresented in other Mollusca. Its principal function seems to be to act as a secure protection to a most extensive and complicated sensory apparatus, which in the Chitonidæ takes the place of the ordinary organs of vision and touch present in other Odontophora, and fully accounts physiologically for the absence of these latter in them. Dr. W. B. Carpenter observed the perforate structure of the tegmentum in Chiton, though he did not examine the nature of the contained soft network. The late Dr. Gray, in his well-known paper on the structure of Chitons, recognised the fact that the tegmentum in the Chitonidæ is something *peculiar* to the shells of this family.

*On a Method of Studying the Behaviour of the Germs of Septic Organisms under Changes of Temperature*, by Rev. Dr. Dallinger.—Description of a new apparatus invented for this purpose.

*A Vegetable Organism which Separates Sulphur*, by A. W. Bennett.—Description of *Beggiatoa alba*, an organism found in the effluent water from sewage-works, known as the "sewage-fungus," which has the property of separating sulphur out of the organic matter in the water, or in the salt used in precipitating the sewage, in the form of minute sharply refringent globules.

*On the Coagulation of Blood*, by Prof. H. N. Martin and W. H. Howell.—The blood of the Slider Terrapin, a turtle easily obtainable in Baltimore, had been used for a number of experiments, the object of which was to determine whether the views entertained by Hammarsten or by Schmidt were most reliable. The general conclusions went to show that the views of Hammarsten were more in accordance with the results of these observers.

Prof. Schäfer asked if the authors had made any experiments with reference to the addition of lecithin and white corpuscles respectively to the blood plasma.

Prof. Martin replied that no experiments had been made with lecithin, but that he had found that the plasma did not clot when entirely free from white corpuscles or a watery extract of them.

*On the Blood of Limulus polyphemus*, by Francis Gotch and J. P. Laws.—The paper was chiefly interesting, as Prof. Schäfer remarked, on account of its indicating the combination of copper with a proteid replacing the usual iron.

*On Vaso-motor Nerves*, by Prof. H. P. Bowditch.—He gave an account of some experiments he had been making to determine the need of vaso-motor nerves. He had employed an entirely new method, namely, the use of the plethysmograph.

*Demonstration of the Co-ordinating Centres of Kronecker*, by Prof. T. W. Mills.—This subject had been previously practically demonstrated to most of the physiologists present. The view, in brief, held by Prof. Kronecker is that there is constituted in the ventricle of the dog's heart a centre which, when injured, is paralysed, and whose function of co-ordinating the muscular movements to form a beat is thus lost, the heart going into what is known as fibrillar contraction, which is wholly insufficient to propel the blood through the body.

Dr. Martin had seen this phenomenon when working on the coronary artery, and thought it due rather to injury of the nerves.

Prof. Schäfer held a somewhat similar view.

Dr. Bowditch asked if, as the injuries referred to were mostly superficial, they did not differ very much from the case in point, which was a deep injury.

Prof. McKendrick thought that if it was merely an injury of a nerve that caused the phenomenon, the heart might be brought back to its natural action; while the fact was a dog's heart, he understood, had never been recovered.

Dr. Mills also stated that Prof. Kronecker would, in consequence of injury of this centre, explain deaths from slight pricks of the heart, sudden death in heart disease in certain cases, and death from chloroform.

Prof. Schäfer thought that from the evidences it was clear electric excitation should not be used to recover hearts suffering from chloroform administration, inasmuch as the phenomenon could itself be caused by the application of an electric current.

Dr. Osler thought the strength of current usually used by physicians in such cases was not so strong as those Prof. Schäfer had in view.

*On the Cardiac Nerves of the Turtle*, by Profs. Kronecker and Mills.—This communication went to show that in the sea turtle there were nerves whose function was perfectly analogous to that of the vagi and accelerantes in mammals. The course of these nerves varied a good deal in different species and in different individuals. It had also been discovered that the pulsating great veins of the land turtle were under the influence of the vagus.

Prof. Martin had found in the Slider Terrapin a ganglion, apparently answering to the thoracic ganglion of the dog, from which the accelerator nerve passed to the heart.

*On the Functions of the Marginal Convolution*, by V. Horsley and Prof. Schäfer.—The object of their experiments was to ascertain the effect of stimulation of localised areas of the marginal

convolution in the monkey, and their results filled up a gap in the well-known work of Ferrier in that they were able to show that removal of certain areas, the excitation of which had previously caused movements of muscles of the trunk, &c., on both sides led to paralysis of muscles of the trunk of such a degree that the animal was unable to stand. By removal of the frontal lobes no paralysis of voluntary movements were obtained. These results were in opposition to those of Munk, of Berlin.

*Ova of Monotremes.*—The President stated that he had a most important announcement to make. He had just received a cablegram from Sydney, from Prof. Liversidge, announcing that Mr. Caldwell, the Balfour Student, who was sent out to Australia to investigate the mysteries in connection with the mammals of that country, had discovered that the Monotremes were oviparous. He did not consider that a more important telegram in a scientific sense had ever passed through the submarine cables before. The Monotremes formed two families characterised by the duck-billed Platypus and an animal which was known to the Australians as the ant-eater. These were the lowest forms of mammals, and it had never been known how they produced their young. The extraordinary discovery was now made that these mammals laid eggs, and that the development of these eggs bore a close resemblance to the development of the eggs of the Reptilia. This discovery proved that these animals were more closely connected with the Sauropsida than with the Amphibia.

*On Sensory Nerve-Sacs in the Skin of Amiurus, a Siluroid Fish;* and *On the Function of the Air-Bladder in Amiurus, and its Relationship to the Auditory Organ*, by Prof. R. Ramsay Wright.—He referred to the numerous species in North American fresh waters, and their remarkable uniformity, almost all belonging to one genus, Amiurus, while tropical fresh waters teem with many different genera differing extremely fr m each other in form. All the species, however, live in muddy waters, and, to make up for the want of the powerful eyesight which characterises the salmon, are provided with an exceedingly sensitive skin and with special tactile appendages on the head. The lecturer described the already known forms of sensory organs in the skin, and then pointed out that certain structures recalling the nerve-sacs of ganoid fishes, like the sturgeon and gar-pike, are scattered all over the body from head to tail, and both on the upper and lower surfaces. This diffusion of these organs is of interest as indicating probably an ancient type of their arrangement. The second point touched upon was the function of the air-bladder and its relationship to the auditory apparatus. Prof. Wright believes the fish becomes sensible of alterations in the pressure of the surrounding water in the auditory apparatus, and suggested that the air-bladder is also an important channel through which sounds are communicated to the terminal organs of the auditory nerve.

In the discussion which followed Prof. Alfred Haddon of Dublin confirmed the latter point, and suggested that this particularly delicate apparatus for receiving sounds was present on account of the fact that tropical Siluroids, at any rate, are capable of producing sounds by means of a stridulating apparatus, some forms of which he had himself described.

## SECTION H—ANTHROPOLOGY

MR. HORATIO HALE read an interesting paper *On the Origin of Wampum.* He said that amongst the Indians it represented mammon, or money, and was equally valued. It had once been actually accepted in Massachusetts and New York as legal currency, owing to lack of silver, and was largely used in the Indian trade. Wampum consisted of a kind of bead or shell, but must not be confounded with the cowries of the East. Indians on the sea-coast drove a large trade in this article, and Long Island was a mine of wealth. The word wampum was of Algonquin origin, and meant white. The speaker explained the various uses to which this material was put. It was generally used in strings and belts, and at the great Iroquois ceremonies it was considered indispensable. Black wampum was more valuable than white. Of the many thousands of belts that had been known to exist during the last three centuries, scarcely fifty remained, and Mr. Hale regretted the dull indifference that had been displayed by the Americans with regard to this interesting and valuable material, valuable as forming a chronicle of the tribes who manufactured the belts. Mr. Hale exhibited an historical belt of wampum, composed of white beads, with four black squares, which, he said, represented four towns. This belt, he said, was one hundred and sixty years old. Another and still more remarkable belt was also shown by the speaker, who explained the emblems upon it, which, he said, were intended to represent the signs of the Christian religion. There were three crosses representing the Trinity, a lamb, executed in a primitive manner, and a dove. These objects, Mr. Hale said, had been evidently suggested to the Indian artist, who had done his best to represent them, but he said that his artistic powers should not be judged by this specimen. The speaker also displayed some strings of beads, and said that these were used in the Indian chants, the beads recalling certain verses to the singers. Mr. Hale showed to the Section a photograph of some Indian chiefs of the six nations who had met at Brantford and explained to him the meaning of their wampum belts. Shell beads, he said, were used in large quantities by the mound-builders, and he argued that it was probable that the art of manufacturing this medium had descended to the modern tribes from their more advanced ancestors. Some beads, which had been found in an enormous burial-place in Orillia county by Mr. Hirschfelder, were shown by Mr. Hale, who said that these were undoubtedly used by the Hurons. Crossing the Rocky Mountains, he said that wampum would be found in actual use, the material itself and the labour devoted to its ornamentation making it extremely valuable. Being susceptible of a high polish, it forms very handsome ornaments, and is better adapted for this purpose than for currency, for which it is cumbersome. Speaking of the amount of shell money possessed by the primitive Indians, Mr. Hale said that the average man owned about one hundred dollars' worth, that being, he said, about the value of two women, two grizzly bear skins, twenty-five cinnamon bear skins, or three ponies. Mr. Hale remarked on the districts in which wampum was found, and quoted some sentences from a work of his own with regard to the discovery of wampum in the Kingsmill Islands of Micronesia in the Pacific Ocean. There, he said, he saw strings of alternate wooden and shell beads. He exhibited to the Section specimens of beads from the Kingsmill Islands and from California, some of these having lost their lustre from the long time which they had been buried in a grave. Mr. Hale made some interesting remarks upon the history of Chinese money or "cash," tracing its origin to the tortoise-shell disks used in earlier times. Mock money, he said, was sometimes burnt at sacrifices, as the Californian Indians burnt their shell money at funerals. He traced the passage of this currency between Asia and America, showing how it could have been brought from one district to another. It was used, he said, by Indians in Eastern North America, those in California, the inhabitants of Micronesia, and the Chinese. He thought that the monetary system was indigenous to China, and that by early intercourse it had been conveyed to this continent. He noticed the fact that Chinese junks and Micronesian prows may have been wrecked on the western shores of America, and that their crews may have introduced the system of shell money amongst the Indians.

Major J. W. Powell read a paper on *The Marriage Laws of the North American Tribes.* In the course of his observations, the speaker remarked upon the custom of burying articles with the dead. There were two classes of property amongst the Indians, communal, or that belonging to the tribe, and personal, or that belonging to the individual. In order to prevent controversy the latter was buried with its owner. With regard to the marriage laws, Major Powell said there were many strange customs. For instance, in some tribes, marriages were arranged by officers of the tribe, and the choice of wife or husband was limited to certain groups of persons. Marriage was therefore not by personal choice, but by legal appointment. But marriage could be performed by elopement, or running away, when, if the couple could remain in safety from detection and punishment until after the day of jubilee, or the day when all offences are considered forgiven, then that marriage would be considered legal. Wives could also be obtained by trial of battle, a contest of some kind, when the woman became the helpmate of the victor. There was also marriage by capture. The methods of obtaining a wife were so common that the custom of marriage by legal appointment was much neglected. But though this was the legal and proper method, the others had become legalised by long custom, and now the capture, contest, or elopement were merely simulated.

Mr. C. A. Hirschfelder of Toronto, as representative of the Numismatic and Antiquarian Society of Montreal, read a paper *On Prehistoric Remains in Canada.* The ancient remains of

Canada have, as yet, been by no means satisfactorily examined, and consequently but superficially described; and although we have no stone ruins, still that does not detract from the interest of the prehistoric works, found scattered over various sections of this country, which are well worthy of a thorough scientific examination. The forts, which were built principally of earth, although stone was not unfrequently used to some extent in their construction, are particularly interesting from two points of view—viz. the almost perfect symmetrical shape, and the advantageous positions which were invariably chosen. As to the first-named feature, they bear a striking resemblance to the ancient earthworks of the Western States, by which some writers have endeavoured to prove that the authors of those works must have been advanced in certain sciences. As to the situation of these forts, their ancient builders seem to have carefully studied localities, and to have fully appreciated the advantages to be gained thereby, as the situations chosen were invariably such as either to command a view for a long distance over the country, or, if near the water, to be so constructed that a fleet of canoes could be seen a long distance away, so that sudden attacks by water would be impracticable. The forts were generally made either circular or oval, although one or two surveyed were crescent or semi-circular, the form probably depending upon the lay of the land; and it is very singular that there has not been, to my knowledge, a single fort discovered in Canada which even approaches a square. Entrenchments seem to have been a not uncommon mode of defence, and have every appearance of being anterior to the wall or embankment forts; the largest one surveyed was half a mile in circumference, of a circular form, and, judging by counting the concentric rings of trees growing right in the ditch, which must have grown after the fort was constructed, also by decayed vegetable-matter and other evidences, was computed to be from 800 to 1000 years old. Ancient burial-places may be classed under three heads—mounds, ossuaries, and single graves. Mounds are not of frequent occurrence in Canada, and all which have so far been examined have contained human bones, proving that they were used as burial repositories. These tumuli (if they may be so termed) are not by any means large; they generally measure about 100 feet in circumference, and are only about 5 feet high. The dead seem to have been buried without any regular system, each mound containing from six to twelve bodies. The ossuaries are probably the most interesting remains we have. They consist of round symmetrical holes dug to the required depth, and into which the bodies were promiscuously deposited; some of the larger ones contain the remains of several thousand bodies. The single graves are the most ordinary remains we have, and are generally found on high ground, a hill-top being a favourite site. In dwelling upon sepulture, I trust to be able to show clearly that the burial of articles with the dead was not so much a religious act as a mark of respect to the dead. The archæological relics of Canada have never been fully described, and are deserving of a higher rank, in a scientific sense, than has as yet been accorded them. We have a grand field to work in, and the articles we find well repay us for the trouble taken. The aborigines of America are undoubtedly the fathers of smoking, and the elaborate workmanship which was bestowed upon their pipes shows the important place it took in their every-day life. There are no articles found which so well portray the aboriginal ingenuity as the pipes. Animals, birds, reptiles, and the human physiognomy are all carved upon the bowls and stems with life-like accurateness. Many specimens found would trouble a clever artisan of the present day to duplicate, allowing him all the modern tools to work with, because stones, tools, ornaments of various kinds, &c., were also manufactured with a precision simply perfect; and, strange to say, it seems to have been a matter of little moment whether they worked the hardest or softest qualities. Pottery, shell, and bone were extensively used in the manufacture of articles for their every-day life, whether for ornaments or necessary utensils; copper was also utilised to some extent, principally for tools, ornaments, and sword-blades; the ore was merely pounded into the required shape. Shells, which must have been brought a distance of nearly 2000 miles, are sometimes found in graves, evidencing the extraordinary fact that a trade must have been carried on between the aborigines of the north and those of the south, which, extending over such a vast distance, and with their primitive mode of travelling, must have made the articles exchanged of great value. The wampum was probably nearly altogether carved from these foreign shells.

Major J. W. Powell, U.S.A., read a paper on *The Classification of North American Languages.* Major Powell said that in his remarks he would confine himself to those languages which possessed at least a thousand words. Pointing to a map of the United States on which the distribution of the languages was marked, the speaker said that there were four great distinctive tongues on the continent, the Aligonquian, the Shoshonian, the Siouan, and the Athabascan. The classification of these languages was impossible, he said, but we could classify the arts, the habits, the philosophy of the peoples. He remarked on the fact that grammars and dictionaries, books, and even newspapers, were published in some of the Siouan languages, the Dakotan for instance. For the purpose of convenience and study of the North American languages, rules had been drawn up and adopted, which rules were read and commented upon by Major Powell. One of these was that family names should not be recognised if they consisted of more than one word, and another that all tribal names should terminate in "an," as Aligonquian and Shoshonian. These were highly necessary to prevent confusion. The speaker described the difficulty he had experienced in classifying the different names during the past fifteen years, and remarked that the affinities of various languages were not yet practically determined. Within a year, the work, he hoped, would be completed, as far as the United States were concerned, but it would take some years before the work for the North American continent was concluded. Four gentlemen were now in the field engaged in collecting vocabularies for this purpose. Remarking on the likeness between the words "kayak" and "caique," Major Powell said that it could be imagined how extremely difficult it was to decide upon such a matter, there being, for instance, eighty languages in North America which possess no affinities with each other. Grammatic affinities might exist, but none closer. He thought that early arts could not be relied upon to connect peoples. Institutions and languages were more valuable and lasting helps to classify nations, the latter especially so. Finally, the speaker said that, as there were eighty different stocks of languages and the same number of mythologies, it would be a long time before their labours were completed.

Mr. Rosefeldt observed that, although he had lived among the Indians for some years, he had never met with an Indian who could pronounce the letter R. In this they were like the Chinese, and therefore might have migrated into America by way of Behring Straits. He related an incident which occurred during his residence amongst the Indians. One of them asking him to what family he (the speaker) belonged, Mr. Rosefeldt replied, the fox, as this animal occurred in his coat-of-arms. The Indian said, "Then I must be your 'pickanniny,'" or son, showing the figure of a snake on his arm, "as the snake is the son of the fox!" This showed that the Indians imagined that they derived their descent from various animals.

Mrs. Erminie A. Smith read a paper *On the Customs and Language of the Iroquois.* Some years ago Mrs. Smith was received into the tribe of the Tuscaroras, and adopted as a sister by one of the chiefs of that nation. An assemblage was held to do honour to this auspicious event, and a handsome bead-work dress was prepared for Mrs. Smith. The chief who adopted her being one of the "Bear" family, she also became a Bear. Mrs. Smith made some interesting remarks upon the costumes and upon the gambling habits of the Indians, and showed some of the silver brooches used by them as stakes in the games. A hair "waterfall," composed of some five hundred scalps joined together, was exhibited, as well as the temperance banner of the Tuscaroras; this bore a rude representation of the American eagle destroying the demon of intemperance, with six stars of the six nations, and figures of the animals which are symbols of the tribes. Noticing the construction of the Iroquoian language, Mrs. Smith said that there were two so-called genders, noble and ignoble; the former comprised God, men, and angels, and the latter demons, the lower animals male and female, inanimate objects, and "women, children, and other chattels."

Mr. F. H. Cushing read a paper *On the Development of Industrial and Ornamental Art among the Zunis of New Mexico.* The speaker's remarks were illustrated by numerous specimens of pottery and other kinds of work done by the Indians. Mr. Cushing said that by adoption of the Zuni language, customs, habits of living, and costume, to the minutest particular, he had been enabled to obtain a vast amount of information regarding these people—descendants, as he said, of the "Pueblo Indians." The word "Pueblo," he explained, was applied to a nation who lived in communal dwellings. He brought forward evidence, linguistic and otherwise, to prove the descent of the Zunis from

these races. He described the causes that led to the architecture of the petty clans, such as a need of protection which induced them to seek the caves in cliffs, and traced the history of the "Pueblo" or communal dwellings. The art of pottery, he said, was practised in the "Pueblo" district to a very great extent. He gave an interesting account of the formation of the Zuni gourds, or water vessels, showing how they were covered with wickerwork in order to preserve them. Basket-work vessels were also used, these latter being covered with a preparation of clay in order to prevent the escape of the contents. Mineral coal was used in the manufacture of earthenware vessels and also upon the corrugated surface given to the bowls. A curious fact with regard to the food utensils of the Zunis was that they regard the bowls they make as possessing something in the nature of life or spirit. They place food and water near the vessel, and as a woman completes it she imagines she has made something like a created being. The different sounds made by the pots as they are struck, or as their contents boil, for instance, are believed to be the voices of the beings which are associated with the vessels. Apertures or blank spaces are left for the escape of this spirit. A Zuni woman, as she closes the apex of a pointed clay vessel, turns her eyes away, and says that it is "fearful" to watch this operation. She thinks that if she knowingly (that is in her sight) closes this orifice, which she regards as a source of life, the source of life in herself may be closed, and that she may be debarred from the privilege of child-bearing. Other evils are also expected to follow if she does not turn away as she completes the vessel's shape by closing the apex. The Zunis, in representing animals, always show a kind of line or passage leading from the throat to the heart, and cannot be induced to dispense with this line in any pictorial representation of animals. In conclusion, the reader of the paper referred to the probable origin of the shapes used in the pottery of America.

Dr. Daniel Wilson then read a paper on *The Huron-Iroquois, a Typical Race of American Aborigines.*—He remarked upon the natural boundaries of countries, and the difficulties they presented to nomadic races. East of the Rocky Mountains the ethnology was comparatively simple. There were but three great races or families, the Iroquois, the Algonquin, and the Athabascan. The Blackfeet were, however, a different race, and possessed different characteristics. West of the Rocky Mountains the subdivisions were more numerous, but not so large. He mentioned the valuable though imperfect vocabulary of Jacques Cartier, which showed something of the language used by the Iroquois or Six Nations. He enumerated the nations of which this confederation was composed, and remarked upon the localities in which they lived. The original native population of this part of Canada, Dr. Wilson said, was the Huron-Iroquois. They were found in the valley of the St. Lawrence by the early explorers. Some of them had been driven out and had returned to Canada at the time of the American Revolution, in one case, he said, bringing with them the silver communion service given to the Mohawk church by Queen Anne, and now used in the Tuscarora church. Dr. Wilson referred to the Indians of Lorette and of Anderdon as representing the ancient type of Hurons. These people, he said, believed that their ancestors came from the neighbourhood of the "great sea" or the Atlantic. The speaker then showed a skull, probably that of a Hochelaga Indian, which had been found near this spot. This, he said, presented all the types of the Huron race. He contended that it was a Huron people that had been found here by Jacques Cartier, though he said that the funeral customs of that nation did not seem to have been practised in this district. These funeral customs, and the ceremony of the "feast of the dead" were described in an interesting manner by the Professor. Dr. Wilson remarked upon the want of knowlege of metallurgy shown by the inhabitants of North America, and the general slow progress in civilisation which was displayed by these people. Copper in large quantities was ready to their hand, but no trace of its being used was found, and the application of fire to the metal seemed not to be thought of. He noticed the earth-works of the Ohio Valley, which he said should be visited by the British visitors before their return to Europe. He concluded by referring to the influence that the half breed population of Manitoba might have in future times upon the inhabitants.

Dr. Tylor, after expressing his thanks to Prof. Wilson for his communication, called upon Mr. Horatio Hale to make some remarks upon the subjects on which the last speaker had touched. This Mr. Hale did, saying that the tradition amongst the Hurons was that their ancestors had moved westward from the districts in which they were found by Cartier. With regard to the question of the language of the Hurons as compared with that of the Iroquois, Mr. Hale read a letter from the Hon. Judge Force, of Cincinnati, who had studied this subject. Mr. Hale also made some interesting observations on the difference of pronunciation between these people, his remarks being listened to with deep attention.

Prof. G. Lawson read a paper on *Food Plants used by the Indians.* The Professor began by remarking on the various berries that were found on this continent, as well as the numbers of nut-bearing trees. He showed that the wants of the aborigines would be supplied by the natural products of the woods and fields, and spoke particularly of the wild potato of Nova Scotia, which was so well known among the Indians. Other plants noticed were the bean, fields planted with this vegetable being found by Columbus and by Jacques Cartier, and maize, which was also much used. Beans were grown among the Indian corn, which formed the main crop. Evidence showed that plants like melons, pumpkins, and others of the same nature were cultivated by the Indians. Columbus, in 1492, found these plants surrounding Indian villages in such a condition as proved that they were cared for.

Lieut. A. W. Greely exhibited a collection of photographs of Esquimaux relics.

Lieut. P. H. Ray read a paper *On the Habits and Customs of the Inu of the Western Shore and Point Barrow.* Many of the natives had been measured, and it was found that the tallest height was 5 feet 10 inches, and the lowest 5 feet 1 inch. This was much higher than the natives of Greenland. Their powers of endurance were wonderful. Marriage laws they had none: the contract was severed at will. They never quarrelled or entered upon any controversy, and were extremely kind to their parents. Lieut. Ray described the manner in which these people prepared their food for travelling, and in which they captured the reindeer and the seal. Though they did not believe in a future existence, they were intensely superstitious, as Lieut. Ray found when he learned their language, and they paid great veneration to the oldest of their women. He thought these people the most primitive that white people had ever come in contact with.

Mr. R. Law read a paper by himself and Mr. J. Horsfall, *On Some Small Flint Implements found beneath Peat on Several Elevated Points of the Pennine Chain lying between Huddersfield and Oldham.*—Mr. Law introduced his subject by saying that, though perhaps of a local nature, it might be interesting. In the course of his paper he said that the flint implements which had been discovered had been submitted to competent authorities, and it was considered that they were the smallest ever discovered in England. They were supposed to have been carving implements, and some of them were not more than one inch in length and a quarter of an inch in breadth, while they were carefully marked and chipped on the edges. The speaker concluded by describing the moorland country and geological character of the soil in which these implements were found.

## SCIENTIFIC SERIALS

THE *Journal of the Franklin Institute* for August contains:—Wire triangular truss, by Chas. J. Quetil, C. and M.E. (illustrated).—New British standard wire gauge.—Report on the trial of the "City of Fall River," by J. E. Sague, M.E., and J. B. Adger, M.E., with an introduction by Prof. R. H. Thurston (continued from vol. cxviii. p. 74, illustrated, and with a table).—Tests by hydrostatic pressure, by S. Loyd Wiegand, M.E.—Velocity of approach in weir computations, by A. W. Hunking and Frank S. Hart (with tables).—The earth's ellipticity, by L. D'Auria.—Suggestions for the improvement in the manufacture of glass, by George W. Holley.—Survey of the future water-supply of Philadelphia, by Rudolph Hering, C.E.—Influence of high pressure on living organisms.—Atmospheric changes at Nice.—Bernauf's telescope.—Microscopic organisms on the surface of coins.—Magnetism in Madagascar.—Selective absorption of solar energy.—Use of oxygen as a refrigerant.

*Annalen der Physik und Chemie*, No. 8, July 1.—On a new method of determining the vapour-densities of bodies with a low boiling-point, by Nik. von Klobukow (10 figures and a table).—On a new method of determining the vapour-densities of bodies with high boiling-points, by Nik. von Klobukow (7 figures).—On the influence of pressure on the viscosity of liquids, particularly of water, by W. C. Röntgen (2 figures and 2 tables).—On the

influence of density on the viscosity of dropping liquids, by E. Warburg and J. Sachs.—On the conductibility of heat of tourmaline, by Franz Stenger (2 figures).—The expansion of crystals by heat, by Eug. Blasius (3 figures).—On the passage of electricity in gas, by F. Narr (with tables).—Remarks on the resistance box of Siemens and Halske, by E. Dorn (4 figures).—On the known dichromatic colour-systems, by Arthur König (1 figure).—On the sensibility of normal eyes for the perception of light of long wave-length, by Arthur König and Conrad Dieterici (1 figure and tables).—Metallic and total reflection of isotropic media explained by means of Neumann's system, by E. Ketteler.—Experimental determination of the wave-length of the invisible prismatic spectrum, by S. P. Langley (5 figures and table).—Demonstration research on the relation between light polarised by reflection and by refraction, by G. Krebs (4 figures).—On a freezing apparatus, by E. Lommæl (1 figure).

*Journal de Physique théorique et appliquée*, August.—On the electric conductibility of very weak saline solutions, by M. E. Bouty (7 parts, 30 pages, with figures and tables).—The influence of heat and magnetism on the electrical resistance of bismuth, by M. A. Righi.—Variation in the physical properties of bismuth placed in a magnetic field, by M. Hurion.—Variation of the resistance of bismuth and some alloys with the temperature, by M. A. Leduc.—On some experiments illustrating an explanation of Hall's phenomenon, by Shelford Bidwell.—Note on Hall's phenomenon, by Herbert Tomlinson.—The explosive wave, by MM. Berthelot and Vieille.—Researches on the compressibility of gases, by E. H. Amagat.—Memoir on the compressibility of air and carbonic acid at 1, 8, and from 20 to 300 atmospheres, by E. H. Amagat.—On a new form of the relation $F(pvt) = 0$, relating to gases, and on the law of the expansion of these bodies at constant volume, by E. H. Amagat.

## SOCIETIES AND ACADEMIES

### SYDNEY

**Royal Society of New South Wales**, August 6.—H. C. Russell, B.A., President, in the chair.—Four new members were elected. Donations received consisted of 327 vols. and pamphlets, forty-six anthropological photographs, and a collection of fossils.—A paper was read by Mr. Lawrence Hargrave on the trochoided plane. The paper was explanatory of some models of animal progression exhibited by the author before the Society, and gave in detail the opinions and deductions he had formed from his observations of the natural motions of animals. The author was of opinion that there was evidence to show that Nature almost universally used the trochoided plane for the transmission of force, and that its use by man opened up a wide field for engineers; he asked the opinion of the members whether there were grounds for believing that the trochoided plane was a distinct mechanical power, and if not under what head they classed it.

### PARIS

**Academy of Sciences**, September 29.—M. Rolland, President, in the chair.—Remarks in connection with a work "On the Origin of the Earth," presented to the Academy by M. Faye. The book is described as mainly historical, recording the various theories on the cosmogony of the universe that have prevailed from primitive times down to the present day.—Observations on a preceding communication dealing with the theory of the form of the planets, by M. F. Tisserand.—On the vegetation of the Amaranthaceæ: distribution of the fundamental substances amongst the various parts of this family of plants and its congeners at the various periods of their growth, by MM. Berthelot and André.—A simple process for effecting the separation of cerium and thorium from mixtures in which these elements are found, by M. Lecoq de Boisbaudran.—On the solubility of the prussiate of gallium; rectification of a previous communication by M. Lecoq de Boisbaudran.—On the trinomial linear equation in matrices of any order, by Prof. Sylvester.—Report of the Commissioners, MM. Bouley, Bert, Gosselin, Marey, Pasteur, Vulpian, and Richet, on various communications touching the treatment of cholera. Of the eight communications received since the last report, five are undeserving of mention. The three others are rather theoretical than practical, and that of Dr. Pereda y Sanchez alone seems to contain a few suggestions worthy of further consideration.—On the second experiment made by MM. Tissandier brothers to propel a screw balloon by means of electricity, by M. G. Tissandier. This trial, made on September 26 at Auteuil with improved appliances, yielded all the results that could be expected from a balloon constructed with an exclusive view to experimental study. The vessel proved perfectly stable, obeying every movement of the rudder, and enabling the aëronauts to execute numerous manœuvres in various directions above Paris.—Observations of Barnard's comet and of Luther's planet made at the Observatory of Nice, by M. Perrotin.—Observations of Wolf's comet made at the Paris Observatory (equatorial of the West Tower), by M. G. Bigourdan.—Observations of the same comet made at the Paris Observatory (equatorial *coudé*), by M. Périgaud.—Observations of the same comet made on September 21 at the Observatory of Bordeaux with the meridian circle, by M. Courty.—Note on the group of points in involution marked on a surface, by M. Le Paige.—Description of a new polarising prism presenting some advantages over those of Nicol and of Hartnack and Prazmowski, by M. E. Bertrand.—Note on the products obtained from tellurium acted on by nitric acid, by MM. D. Klein and J. Morel.—On the employment of the sulphate of copper (blue vitriol) for the destruction of mildew, by M. Ad. Perrey. Vines recently treated with this solution in the department of Saône-et-Loire were everywhere distinguished from the surrounding plants by the bright green colour and healthy appearance of their foliage. But this remedy seems to be efficacious only in the case of young vines from four to six years old.—Report on the present climatic conditions and sanitary state of the isthmus of Panama, by M. R. Regnier. The prevailing notions regarding the insalubrity of this region appear to be unfounded. Its temperature varies from 24° to 30° C. in winter, rising to 35° in summer. The climate is hot and moist, with two seasons, summer and winter, the latter being the rainy season and the shorter of the two. Although the climate does not produce the same depressing effect on Europeans as many other tropical countries, certain hygienic precautions should be taken and scrupulously observed. Two large hospitals, one at Panama, the other at Colon, have been erected for the treatment of the men at present employed in the construction of the canal. A health resort has also been established at Taboga, and these various measures are stated to have reduced the mortality almost to a lower rate than in many great centres of industry. It is at present about 2·5 per cent., a proportion not exceeding the average of European countries.

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